



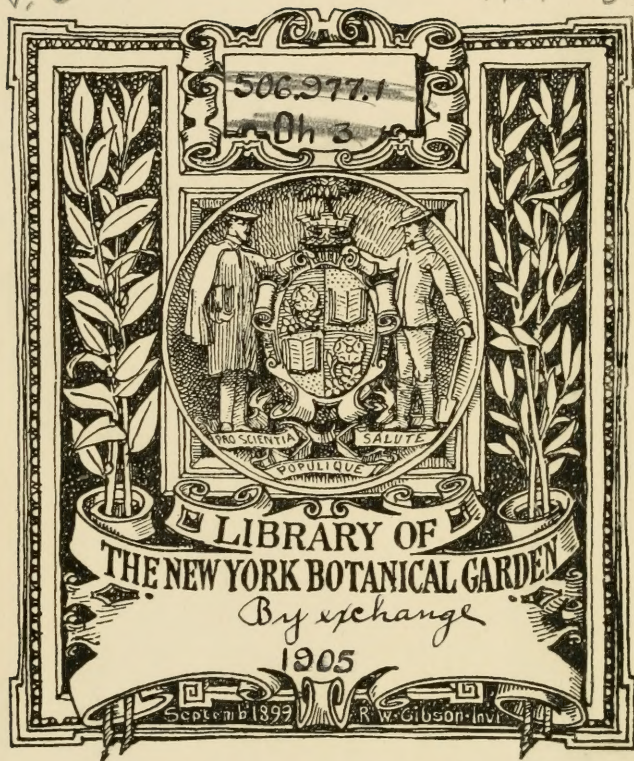
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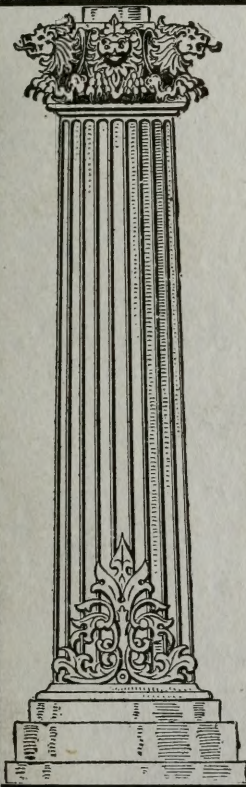
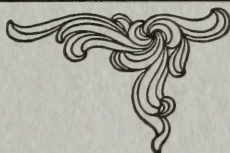
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(Vol. 3 no. 1)



OHIO
STATE
ACADEMY
of SCIENCE



Ninth Annual Report

NINTH ANNUAL REPORT
OF THE
OHIO STATE
ACADEMY OF SCIENCE
1900.

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Published by the Academy.
Columbus, Ohio, 1901.

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NINTH ANNUAL REPORT
OF THE
OHIO STATE ACADEMY OF SCIENCE.

WINTER MEETING.

The tenth annual meeting was held at the Ohio State University, Columbus, December 26th and 27th. Only thirty-one papers were read—the smallest number since 1893—so that the Academy adjourned at noon of the second day. The attendance, however, was as good as usual. The Academy has been steadily growing in membership and in the quantity and quality of work accomplished. It has now the satisfaction of contemplating the beginning of a survey that will result in good topographic maps of Ohio, which will be of great service not merely in facilitating the progress of geological and biological investigations within its borders, but also in primary education and in the solution of problems constantly arising in sanitary and commercial engineering. Without the efforts of the Academy or some similar organization it is not probable that any legislature for many years to come would have made an appropriation for such a survey. Mr. McMillin again put \$250 at the disposal of the Academy for the promotion of original research.

REPORT OF BOARD OF TRUSTEES.

Your trustees beg leave to submit the following report: As the Academy is coming into possession, by exchange, of many valuable reports, monographs and other papers

and it is necessary that these be kept in some proper place where they will be as accessible to the members as is possible, we have appointed Mr. W. C. Mills as librarian, and to him should be sent all publications belonging to the Academy, except its own. We have appointed Professor Herbert Osborn, custodian of all of the duplicate publications of the Academy, consisting at present of its annual reports and special papers.

From the McMillin research fund we have made the following grants:

To Professor Raymond Osburn, to enable him to finish his studies of Ohio Fishes.....	\$50 00
To Professor Bonser, to enable him to study the flora of some special localities in the State.....	25 00
To Professor Williamson, to aid him in classifying the streams, lakes, etc., of the State.....	14 45
To Gerard Fowke, to enable him to study the preglacial drainage of the vicinity of Cincinnati, Ohio.....	25 00
To Professor Hine, to enable him to study the insect fauna of some special sections of the State.....	50 00

We have paid out for engraving maps for the special paper on preglacial drainage, which is to constitute No. 3 of the series, \$38.21.

Prof. Bonser has not yet drawn his grant and Prof. Hine, owing to an unexpected call for his services in nursery inspection, has not used all of his grant, and desires the remainder to be continued another year.

We have now in our hands \$187.39. Deducting from this the unpaid grants of Professors Hine and Bonser, and \$100.00 for publication, we have approximately \$37.00 unappropriated. Of this we shall probably use about \$7.00 for engraving a large map illustrating the entire preglacial drainage of the State so far as it has been discovered, leaving us a net balance of \$30.00 unappropriated. Professor Osborn's report on the Fishes of Ohio will be ready for publication early in 1901, but we hope that the Academy funds will be sufficient to publish this, leaving

us to use Mr. McMillin's fund as he wishes it to be used, viz., in aiding entirely competent and experienced investigators, not otherwise provided with financial support, to carry out their researches.

F. M. WEBSTER,
Chairman.

HENRY C. BEARDSLEE,
JOHN H. SCHAFFNER.

It was shown that the appointment of Professor Osborn, the treasurer, as custodian, by the trustees, was partly in conflict with a resolution passed at the Cleveland meeting of the Academy, and the following motion was carried:

"That the resolution on separate publication of a series entitled, Ohio Academy of Science, Special Papers be so amended that the section which now reads, "The papers to be in the custody of the treasurer of the Academy who shall include an enumeration of unsold copies in his annual reports" shall read, "The Papers to be in the custody of the Trustees."

REPORT OF PUBLICATION COMMITTEE.

During the year passed we have published only the annual report of the Academy, 82 pages, at a cost of \$44.89. No. 3, Special Papers, is now in press, and will be mailed within a short time. We regret the delay in the publication of this, but so far as your committee is concerned it has been unavoidable. The maps for this publication have been paid for from the McMillin fund, as, indeed, they must be, as no part of the Academy funds can be used for this purpose, without a change in the by-laws. Professor Tight has furnished free of charge several half-tone illustrations to accompany his paper in this number of the series.

We would urge the Academy to do the printing from its own funds, leaving the McMillin research fund to be applied in strictly research work.

We also are of the opinion that better printing should be done, even at an advanced price. Special Papers No. 3, is being printed in Columbus, and the report should be given to either the same or an equally competent firm.

F. M. WEBSTER,

Chairman.

JOHN H. SCHAFFNER.

REPORT OF THE COMMITTEE ON TOPOGRAPHIC SURVEY.

Your committee are happy to report success in their endeavors. The State Legislature, at its last session, voted to enter into coöperation with the United States Geological Survey for the production of a topographic atlas of the state, and appropriated twenty-five thousand dollars toward the support of the work for the year 1901.

The survey being thus inaugurated, there is good ground for believing that it will be continued and carried to completion.

The success of the movement is largely due to the appreciative support of Hon. A. G. Comings of Lorain county and Hon. W. S. McKinnon of Ashtabula, together with the liberality of the U. S. Geological Survey in furnishing samples of their work in other states, in response to the requests of your committee.

Respectfully submitted,

ALBERT A. WRIGHT,

Chairman.

W. G. TIGHT,

C. E. SLOCUM,

GEO. W. GILL,

J. A. BOWNOCKER.

Several members spoke in commendation of the services of Professor Albert A. Wright, who first brought the matter of a topographic survey to the attention of the Academy in his address as president in 1896 and who, as chairman of the committee established at that time, had

labored diligently in behalf of the measure. A vote of thanks was extended to him.

REPORT OF COMMITTEE ON COLOR STANDARD.

The committee would recommend to the Ohio Academy the Prang standard of color and advise the use of this standard in their descriptive work wherever practicable, preferring, however, the full terms so as to be intelligible to persons not having the key. In case a well known and clearly understood name can be used this should be given with the Prang equivalent in parenthesis.

The use of metallic colors such as golden, silvery, coppery, etc., should also be retained.

H. C. BEARDSLEE,

HERBERT OSBORN,

Committee.

Fourteen persons were elected to membership.

Wednesday evening the president, Dr. Lindahl, gave a very interesting description of his observations among the Eskimos in Danish Greenland. Following this and suggested by it, remarks were made by several members concerning popular prejudices with regard to certain kinds of food and the peculiarities of different peoples in the food they use.

The vice president, Lynds Jones, spoke of the desirability of a new list of the birds of Ohio.

PAPERS READ.

1. A study of North American Scorpion flies -- JAMES S. HINE
2. Observations on the animal life of Cedar Point --
-- -- -- -- -- HERBERT OSBORN
3. Annotated catalogue and outline of monograph of the
Ohio Junci -- -- -- -- -- HARRIET G. BURR
4. Annotated list preliminary to a monograph of the Ohio
species of mosses -- -- -- -- --
-- -- -- W. A. KELLERMAN and ETHEL HERRICK
5. Annotated list preliminary to a monograph of the Ohio
lichens -- W. A. KELLERMAN and J. C. HAMBLETON
6. Annotated list preliminary to a monograph of the Ohio
smuts -- -- -- -- -- W. A. KELLERMAN

7. Additions to the list of Hemiptera of Ohio - HERBERT OSBORN
 8. New species of birds collected in Lorain county - LYNDY JONES
 9. Notes on plants for 1900 - - - - A. D. SELBY
 10. Notes on the self-pruning of trees - - - -
- - - - JOHN H. SCHAFFNER and FRED J. TYLER
 11. Some mastodontic pipes - - - - J. P. McLEAN
 12. Report on ecological study of Big Spring prairie - -
- - - - - - - - THOMAS BONSER
 13. A new insect pest in Ohio - - - - F. M. WEBSTER
 14. Six new species, including three new genera of fossil
plants - - - - - - - - A. HERZER
 15. Remarks on the fleshy fungi - - - - H. C. BEARDSLEE
 16. The classification of the Waverly series of central Ohio
- - - - - - - - CHARLES S. PROSSER
 17. Note on a case of recent stream capture near Cleve-
land - - - - - - - - GEORGE R. TWISS
 18. A rock valley crossing Huron and Erie counties - -
- - - - - - - - E. L. MOSELEY
 19. Interpretation of the drainage modification of South-
eastern Ohio - - - - - - - - W. G. TIGHT
 20. Electro-magnetic induction considered as a means of lo-
cating and tracing sub-surface streams of water -
 21. Whirlwinds and tornadoes considered as examples of
electro-magnetic rotations - - - - -
 22. Physical conditions of the earth thought to be favorable
to the production of whirlwinds in certain localities
- - - - - - - - J. G. SUTTON
 23. Note on the distribution of *Taraxacum erythrocarpum*
- - - - - - - - W. A. KELLERMAN
 24. Old-squaw ducks (not "pintails") caught in deep water
fish nets - - - - - - - - E. L. MOSELEY
 25. Remarks on archæology - - - - - W. C. MILLS
 26. Notes on the Isopoda of Ohio - - - - JOSUA LINDAHL
 27. Report for 1900 on the state herbarium, including addi-
tions to the state plant list - - - - W. A. KELLERMAN
 28. Some distribution notes - - - - - F. M. WEBSTER
 29. Notes on the cocklebur - - - - - E. E. MASTERMAN
 30. Some experiments in the exportation of beneficial insects
- - - - - - - - F. M. WEBSTER
 31. Occurrence of *Anthurus borealis* at Cleveland H. C. BEARDSLEE
- PRESIDENT'S ADDRESS — Comparative measurements of 46 specimens
of *Amblystoma microdonum*.
- COPE — A study in variation, with some introductory remarks
- - - - - - - - JOSUA LINDAHL
- E. L. MOSELEY, *Secretary*.

SUMMER MEETING 1900.

The meeting at Put-in-Bay, June 26-28, was carried out in the main in accordance with the program published June 18. About thirty members were on the island, but several of them spent the whole time at Hotel Victory, where the State Teachers' Association was in session. Rattlesnake Island was visited Tuesday afternoon and Middle Bass Wednesday forenoon, the lake being too rough at that time for the launch to reach Marblehead or Kelley's Island.

At the meeting at the Cincinnati Club House Tuesday evening twelve new members were elected and communications from Past Presidents G. Frederick Wright, in China, E. W. Claypole, in Pasadena, California, and Albert A. Wright, in Clifton Springs, New York, were presented in brief. The Academy's success in inducing the recent legislature to coöperate with the U. S. Geological Survey in undertaking a topographic survey of the entire state was mentioned in connection with the name of A. A. Wright, the prime mover and energetic leader in what the secretary considered the most important achievement of the Ohio Academy thus far.

E. L. MOSELEY,
Secretary.

IN MEMORIAM.

EDWARD ORTON.

In the death of Edward Orton, teacher and scientist, for many years State Geologist of Ohio, formerly President of the Ohio State University and intimately connected with the development of that institution, who also honored the Ohio State Academy of Science by accepting its presidency for the brief term customary in our organization, we in common with scientists through the United States acknowledge ourselves heavy sufferers.

Born in Deposit, Delaware county, N. Y., March 9, 1829, educated under parental direction, in the academies of Westfield and Fredonia, N. Y., and in Hamilton College, from which he graduated in 1848, he served as a professor of natural sciences or of his chosen one, geology, from 1856 until his death on October 16, 1899. It was his portion to have lived and to have been a science teacher throughout the period of conflicting opinions regarding the value of science in educational affairs, which may be said to have been ushered into the world, for our century at least, about the beginning of his professional career; it was likewise his good fortune to see his own high estimates of the value of the teachings and method of science accepted in the world of thought. Though we can little realize, in our day of science accepted and honored both in educational affairs and in the various departments of investigation, the heated controversies of the earlier period, we may honor ourselves by grateful tribute to his high attainments and the great good he has done in the world by his life and labors.

Some of us were his pupils, and add the personal offering to that of scientists; we cherish the recollections of the class room and the rich friendship this opportunity gave us.

As members of the Ohio State Academy of Science, assembled in annual meeting in Columbus, his late home, we join in these humble expressions of our appreciation of the character and services of Professor Edward Orton and in recording our personal bereavement.

A. D. SELEY,

J. A. BOWNOCKER,

Committee.

MANNING F. FORCE.

The scope of a State Academy of Science is attested by the men who unite in the common pursuit of truth. General Force achieved for himself distinction as a lawyer, a soldier and a jurist aside from his attainments in science, and his skill as an executive officer exhibited in his career as commandant of the Soldiers' Home at Sandusky, Ohio.

Manning F. Force was the son of a lawyer, the compiler of the American Archives; he was graduated from Harvard College in 1845 at the age of 20 years, and from the law school three years later. He practiced law in Cincinnati from 1850 till the beginning of the war of the rebellion, then enlisting as major in a volunteer regiment; he was subsequently promoted to the office of colonel by gradual stages. He was awarded the Seventeenth Corps gold medal of honor after the capture of Jackson by General Sherman; he later commanded a brigade of this corps and exhibited great gallantry in the operations before Atlanta. Here he was severely wounded. At the close of the war he was brevetted major general for "especial gallantry before Atlanta." It is said of General Force that "During the whole war he lost not a wagon, a caisson nor a cannon and his command, though always in the extreme front, was never taken by surprise, and never gave way under fire."

Returning to the walks of peace, he was elected a judge of the Court of Common Pleas at Cincinnati in 1866, and re-elected at the close of his term in 1871; he was advanced to the position of judge of the Superior Court of Cincinnati by election in 1877 and re-elected in 1882, being at the latter date the nominee of both political parties for that position. He declined re-election in 1887 and the next year accepted the appointment as commandant of the Ohio Soldiers' and Sailors' Home, Sandusky, where he served until his death in 1899. In other lines Judge Force

was active; for twelve years he was a professor in the Cincinnati Law College; for twenty years President of the Historical and Philosophical Society of Ohio, as well as a member of several other societies devoted to history and archæology. His published writings cover campaigns of the civil war, biographical sketches and discussions concerning the prehistoric races and mound builders. In our own Academy he was liberal in promoting researches in archæology, and in contributing to the progress of the organization.

In character blameless, in the discharge of duty thorough and uncommonly efficient, and in all relations retiring and unselfish, we join his many friends elsewhere in grateful acknowledgment of his many services and the living force of his example.

A. D. SELBY,

J. A. BOWNOCKER,

Committee.

PAPERS AND ABSTRACTS.

THE OCCURENCE OF ANTHURUS BOREALIS BURT. IN NORTHERN OHIO.

H. C. BEARDSLEE.

Anthurus borealis Burt, was described in 1894 from specimens found in cultivated fields in New York state. It has since been found in a few other localities in the same state and also in the vicinity of Boston. Its occurrence in northern Ohio is of great interest and indicates a much wider distribution than has heretofore been attributed to it.

During the past three years it has appeared near Cleveland in the autumn months, though each year it has been detected in a different station. The past autumn it was found in considerable abundance in a market garden.

It seems well distributed near Cleveland and will doubtless be found not to be rare in northern Ohio as it becomes more thoroughly explored mycologically.

OLD SQUAW DUCKS (NOT "PINTAILS") CAUGHT IN DEEP WATER FISH NETS.

E. L. MOSELEY, SANDUSKY, OHIO.

In the article, Occasional Abundance of Certain Birds on or near Lake Erie, published in the last annual report, I quoted a letter from John R. Schacht, of Erie, Pa., telling of a great number of "pintails" caught in deep water. Recently he has informed me that the ducks were old-squaws. He also says:

"On November 16th, 1900, the tug Uncle brought in from five hundred to five hundred and fifty old-squaw

ducks, caught in a depth of water varying from eighty to one hundred feet, seventeen miles out in the lake on a northwest course from the Erie harbor light. One week prior to this date large quantities of these ducks were brought in by the boats, and on the day mentioned several boats came in with fully as many as the tug Uncle."

NOTES ON THE COCKLEBUR.

E. E. MASTERMAN, NEW LONDON, OHIO.

In July, 1896, Dr. Claypole, of Akron, Ohio, asked me to find how general was the opinion in my locality as to whether one seed of the two in the cocklebur grew the first year after maturing and the other the second year.

As opportunities presented, I asked perhaps twenty of the older farmers. None of them seemed to know anything about it except that enough seeds grew to injure the price of wool.

The following year, 1897, when coming home from Wooster, Ohio, an old German told me that one seed always grew one year and the other some other time. Never both at the same time.

Not long after that I saw a statement of Prof. Arthur's experiments (Ohio Experiment Station Bulletin No. 83, September, 1897, page 353), confirming the opinion of the old German, since his own experiments had not been able to produce two plants from one bur at the same time.

I then became interested and greatly desired to know and test for myself. I gathered a quantity of burs and in the spring of 1898 I planted 1,000 burs, of which 917 burs grew two plants. In 1899 I planted another 1,000 burs, of which 921 burs grew two plants. In 1900 I planted another 1,000 burs, of which 913 burs grew two plants. Of the 3,000 burs planted in three years 2,751 burs grew two plants. Of the remaining 249 burs some grew one plant, some did not grow at all, some had two seeds apparently

alive, some appeared to have decayed and some not developed. At the same time each year I examined 1,500 wild specimens where two plants grew together, and more than five inches from any other plant, and found that in every case of the three years' observing two plants grew from one burr. A hand force pump carefully used played an important part in the last experiments.

The ground in which I planted the 1,000 burs each year was taken from the banks of the creek where they naturally grew; sifted through a one-quarter inch mesh wire sieve and carefully examined with hand glass. Taken to a part of the farm where they did not grow, the burs were then planted and left to the weather as the self-seeded plants.

The only point I wish to make is that the two seeds in the same bur can be made to grow at the same time in my locality. The reason why I had such a widely different result from Prof. Arthur I cannot tell. Perhaps locality, climate or physical conditions of which we know nothing—perhaps another variety—I cannot tell.

[NOTE.] Much discussion followed. Upon suggestions of Professors Kellerman, Moseley, Schaffner and others, I shall continue experiments next year on several other lines and report at next winter's meeting.—E. E. M.

*REPORT ON ECOLOGICAL STUDY OF BIG SPRING PRAIRIE.

THOS. BONSER AND W. A. KELLERMAN.

In the autumn of 1899, we began the investigation of the ecological factors of the plant life on Big Spring Prairie, which is situated in the counties of Wyandot, Seneca and Hancock. This prairie is about ten miles long and from a quarter of a mile to a mile wide. Its shape is almost that of a horse-shoe.

Our investigations were conducted along the following lines:

1. Geological formations surrounding the prairie, and the characteristic vegetation of same.
2. Past condition of prairie, especially since 1832, in which year the Big Spring Indian reservation was thrown open to settlement.
3. The drainage of the prairie, past and present, and its effect upon the general level of same, and also upon the character of the vegetation.
4. The lagging behind of effects, as shown by plants clinging for a time to a locality after the conditions have changed; in this instance from the hydrophytic to the mesophytic.
5. The nature of the soil in the various portions and the characteristic vegetation of same at present time.
6. Tree introduction upon the prairie; the order and cause.
7. The prairie under cultivation; the crops grown upon it; the original species of plants, which still maintain their foothold; the introduced species of plants which become most troublesome.

*This work is conducted under a grant from the McMillin fund.

SIX NEW SPECIES, INCLUDING TWO NEW GENERA, OF FOSSIL PLANTS.

H. HERZER.

Palacophycus, Hall. *Palacophycus clavifrons*. Nov. Spec.

(Plate I.)

A much ramifying marine weed, shooting at once at sharp angles a number of branches, which at distant intervals multiply again in the same manner. Each branch seems a barren, rugged cylinder, beginning at its outgrowth thin as twine, then assuming a thickening of $\frac{3}{8}$ inch, giving the rather lengthy branches a club-like form.—Sand-sone flagging, Harmar Hill, Marietta, Ohio.

Caulopteris, Ll. and Hutt. *Caulopteris magnifica*,
Nov. Spec.

(Plate II.)

Among the numerous silicified remains of plants of the carboniferous age, from Athens county, Ohio, that have been liberated out of the Mahoning sand-stone, we find quite a variety of species grouping under different genera, which are by their internal organization closely allied to each other. The great interest in these thus preserved plants is presented in the minute preservation of internal structure by which their classification is greatly facilitated and at once obvious.

Our species here is a well preserved, magnificent tree-fern, once beautifying the unbroken wilds of its time.

Stem half-flattened by compression; scars in longitudinal series, very large, continuous, acute-elongate, naviform, joined by their extremities, upper half raised, in the middle abruptly terminating with a high embossment roughly corrugated; lower half granulated with fine deep lines; from abrasion surface of the bark smooth, under-surface furrowed, decorticated stem granular-linear, exposing in short raised lines its structure. This beautiful silicified specimen is thirteen inches long and six inches across. The scars are $4\frac{1}{4}$ inches long and $1\frac{1}{2}$ inches broad, deeply impressed.

The well-preserved internal structure of cross-section Fig. 2 exhibits long vernacular woody fascicles of darker color, narrow, linear, flexuous, incurved, calvate; unsymmetrically arranged. Fig. 3 shows cellular structure of an enlarged fascicle; sharp angular, thin-walled; the surrounding tissue composed of sub-circular, oval cells, Fig. 4, loosely joined. These two organizations of tissue form the interior character of the plant.—Mahoning Sandstone, Athens Co., Ohio.

Cystiphycus latifrons, a New Genus.

Like many other fucoids this species had the same mode of growth. Large, broad fronds enclosing cylindrical stems

in perfoliate, decurrent or spiral manner is common among seaweeds. Numerous large smooth surfaces with striation are often found packed with other marine flora in the sand-rock and not unfrequently small circular fractured dots as large as small peas on them, indicating broken-off cysts that once gave support to large heavy fronds of seaweeds. This

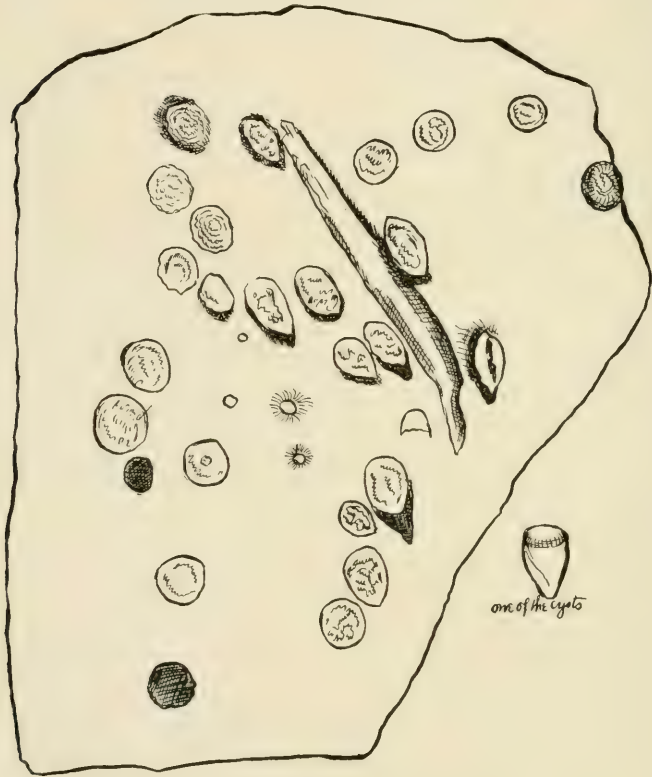


FIG. 1. *Cystiphyucus latifrons*.

latter was the case with *Cystiphyucus latifrons*. Our fossil shows a lengthy part of a cylindrical stem with a large piece of a frond 6x8 inches, covered by about twenty-five cysts, or air vesicles, one-half inch thick, elongate globular, truncate above and tapering downward to their attachment like reversed cones. Some are fairly projecting, some buried in the rock, others broken off.

From a 4-foot sand-stone stratum interlaid between two heavy strata of red clay.—Coal Measures, Marietta, O.

Psaronius juncus, Nov. Spec.

(Plate III.)

As has been shown in one of our former meetings, *Psaronius* is not a conical stalk of aerial roots, enclosing the base of tree-ferns, but it is a plant *per se*. We present the one before us as a new species, having in its central arrangement the structure of a fern or *Sigillaria* or likely a *Lepidodendron*; for all these characters are closely allied to each other; but also being remarkably made up of cellular fascicles, enclosing like individuals that center and joining each other so densely, as to leave no interstinct tissue between them. Each fascicle is throughout the whole trunk, which attains the thickness of $1\frac{1}{2}$ in., as thin and slender as bulrushes, from $\frac{3}{16}$ to $\frac{1}{8}$ inch thick, crowding each other in various angles. In each fascicle is a starlike center of coarse woody cells, surrounded by small circular cells. The main center, 2 inches in diameter and being a pithy cylinder, has the same long vermicular woody bundles as are common to the abovementioned trees.

Psaronius is abrupt truncate, having a wide, deep crateriform cup or basin; from each fascicle issued a leaf and from the depth of the center a shaft bearing the sporiferous fructification. Our specimen bears remarkably four notches of branches as offshoots from the exterior in quincunx arrangement.—Mahoning Sandstone, Athens Co., Ohio.

Arthrophycus, Hall. *Arthrophycus elegans*, Nov. Spec.

This species of seaweed is very similar to *Arthrophycus Harlani* of the Medina sand-stone; its close division of branching and transverse furrows or ridges bring it in close relation with the former; only that the new species is of very dense growth, with more graceful and slender branches and closer and deeper furrows. The marks left in the rock look much as if stems of crinoids of various

thicknesses had been impressed. The delicate branches $\frac{1}{16}$ inch in width count fifteen furrows to $\frac{1}{2}$ inch length. The stouter branches measuring $\frac{3}{16}$ inch have much broader transverse ridges. It is found in a 4-foot stratum of sand-



FIG. 2. *Arthrophykus elegans*.

stone, interstratified between two heavy strata of red clay, used for brick-making.—Coal Measures, Marietta, Ohio.

Nodophycus thallyformis, a New Genus.

(Plate I, Fig. 2.)

The fronds of this seaweed must have been very large. I find them covering large slabs of sand-stone. The nodose elevations of the frond are from one-third to one-half inch apart and look as if a soft thallus had spread over peas.—Carboniferous Sand-stone, Marietta, Ohio.

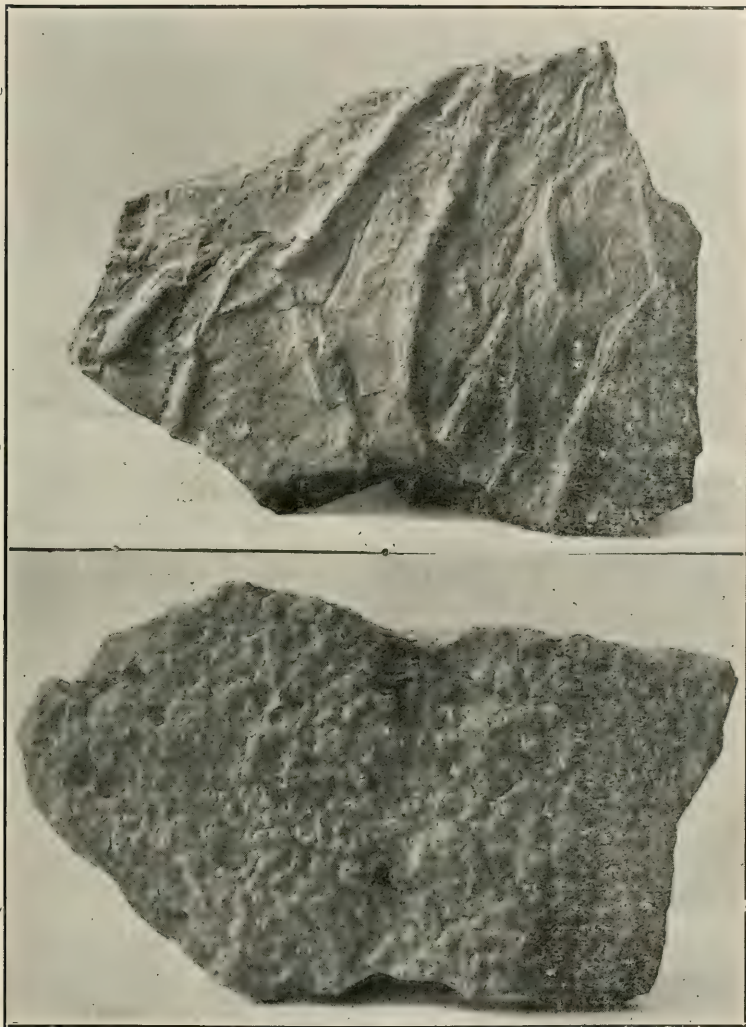
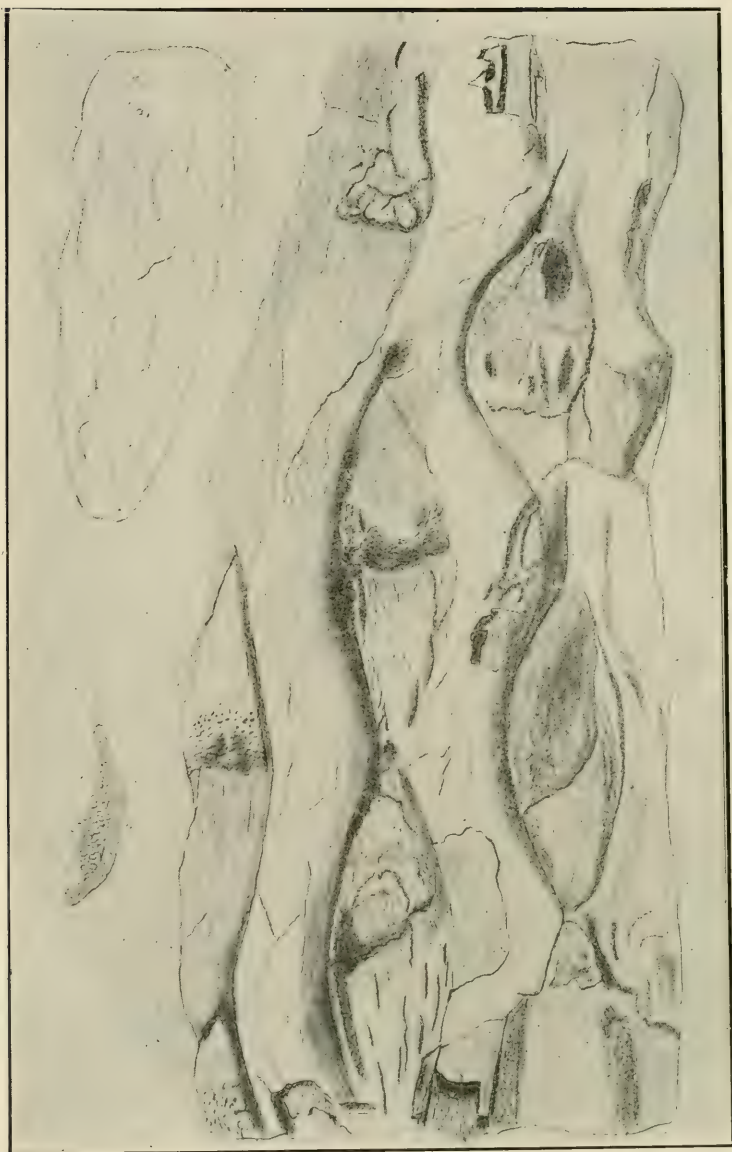
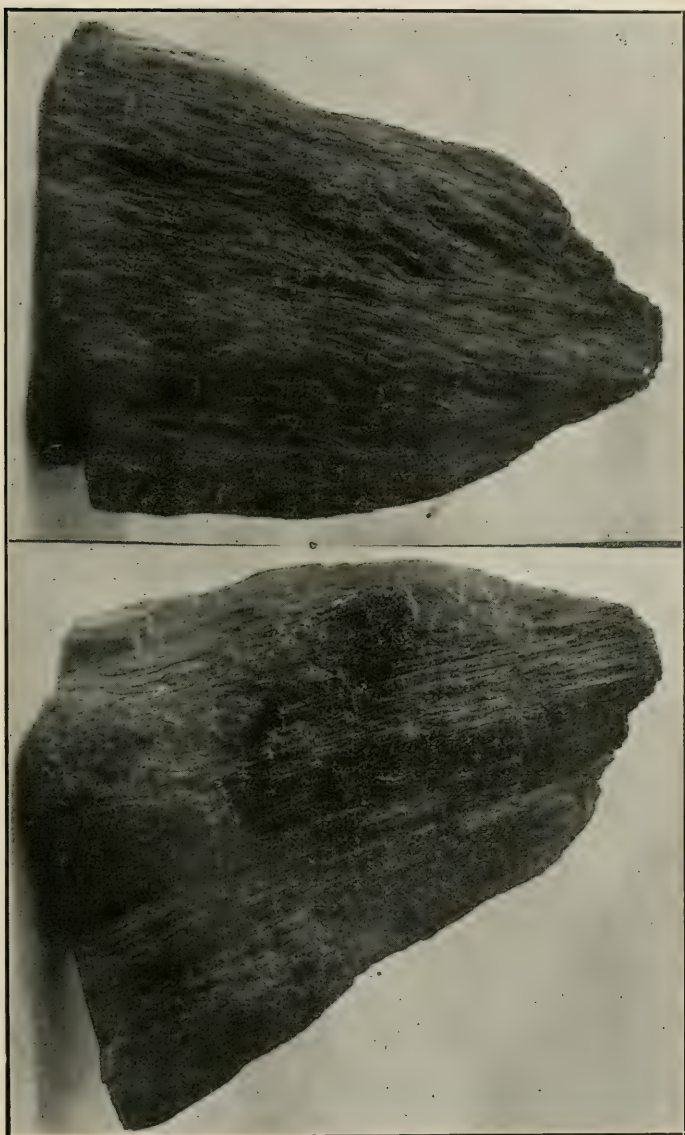


FIG. 1. *Palaeophycus clavifrons*. FIG. 2. *Nodophycus thallyformis*.



Canlopteris magnifica.



Psaronius juncus.—FIG. 1. With two notches of branches; outer surface. FIG. 2. With one notch to right and a lower central embossment, and a part of the central pith.

A NEW FOSSIL SPONGE FROM THE COAL.
MEASURES—(With Plate 4).

H. HERZER.

Sphenodictya cornigera, a new genus.

This sponge begins with an obtuse, compressed cup, spreading gradually at an angle of 35 degrees and pursuing this compressed and widening plan with a gradual thickening to an inch at its length of $3\frac{1}{2}$ inches. It is perfectly wedge-shaped, its margins are obtusely rounded and the right margin bears a ridge-like swelling from base to top. The body is marked with very faint linear longitudinal striae; a heavy cornice more than one-half inch thick overtops the structure, projecting at its left end a cornice

*Sphenodictya cornigera*.

of three-quarters of an inch in length, while the right angle rounds off projectingly the ridge from below. This cornice being four inches long is also marked with faint longitudinally oblique striation. Of its once delicately glassy structure nothing is left.

From a four-foot stratum of sand-stone, densely packed with seaweeds, interstratified between two heavy strata of red clay, used for brick-making.—Coal Measures, Marietta, Ohio.

ANNOTATED CATALOGUE AND OUTLINE OF A MONOGRAPH OF THE OHIO JUNC.

HARRIET G. BURR.

There is room for some misunderstanding in the term “rushes” as we ordinarily use it. The best known of the so-called rushes is probably the bulrush—*scirpus*, of the family of the true-sedges, *Cyperaceae*. The species of this are the common sedges found growing in wet places.

Several species of *Cyperus* and all of those of *Scleria* in the same family, and some of the horsetails and other plants, are also called rushes—the name being given, somewhat indiscriminately, to many aquatic or marsh-growing endogenous plants with soft, slender stems.

But the *true rushes* are the *Juncaceae*. They are so named from the Latin *jungere*, to bind, in allusion to their use as withes.

They are worth some consideration for their economic value; the pith of some species is made into wicks for lamps and tallow candles—whence the name “rush-lights.” *Juncus effusus* and *Juncus conglomeratus* are plaited into mats, chair-bottoms and small baskets.

There are seven genera of the *Juncaceae*, and about two hundred species, widely distributed, but most abundant in the North Temperate zone. Of these about two-thirds belong to the genus *Juncus*, and are summer blooming. The only other genus represented in the United States is

Juncoides to which belong altogether forty species. These bloom in spring.

Juncus effusus grows in almost all countries of the globe, *stygicus* is alpine or arctic, *balticus* and *gerardi* grow principally near salt water. As a rule the members of this family grow in wet or moist places, but some species grow only where it is dry; *tenuis*, a small, wiry species, is found among the grass and especially on old roads and cowpaths.

The earliest description which I have found of the Junci, except the descriptions of Linnaeus in the *Genera Plantarum*, is the one by Engelmann—an elaborate monograph published in the *Transactions of the St. Louis Academy of Science*, 1866-68. In the introduction to this Dr. Engelmann says:

“The difficulty I found in arranging the species of *Juncus* of my own herbarium, the doubts in which the authors left me by incomplete and unsatisfactory descriptions, and by confusion in the names and synonyms, the want of confidence which all my correspondents, even such as had paid a good deal of close attention to it, seemed to place in themselves and their own judgment when this genus was under discussion—all this induced me to enter upon a critical study of our Junci.”

Liberal contributions of specimens and observations from all over the country and from Europe helped in this work. He was able to examine over a thousand specimens; he made careful dissections and drawings of flowers and fruits, and his monograph includes descriptions of plant characters, a key to the classification, notes on geographical distribution, etc.

A later monograph is that of the order by Dr. Buchanan in Engler and Prantl, while the text for Juncaceae in Britton and Brown is by F. C. Coville, head of the department of botany at the National Museum.

The classification of the Junci is according to characters taken from the organs of vegetation, from the stem and leaves and inflorescence, more than from differences in the flowers and fruits. The types are characterized also by dif-

ferent forms of root-stocks. The plants are liliaceous in structure, though otherwise sedge-like. The flowers are single or loosely clustered or in spikes or heads; they are small and regular, six-parted, the parts glumaceous. In contrast to this, the Cyperaceae are destitute of a perianth, or with bristles or scales in its place.

Britton and Brown give forty species of *Juncus* and seven of *Juncoides*.

Of the Ohio Junci, with their distribution, the following are represented in our herbarium.

- J. effusus* — 15 counties.
- balticus* — 1 county (Erie).
- bufonius* — 3 counties.
- gerardi* — 1 county (Cuyahoga).
- tenuis* — 22 counties.
- marginatus* — 2 counties.
- articulatus* — 1 county (Cuyahoga).
- nodosus* — 2 counties.
- torreyi* — 3 counties.
- scirpoides* — 1 county (Erie).
- brachycephalus* — 4 counties.
- canadensis* — 4 counties.
- acuminatus* — 9 counties.

Listed in our catalogue but not represented in the herbarium are *filiformis*, *stygicus*, *richardsonianus* and *brachycarpus*.

In addition to our list, *effusus*, *tenuis*, *marginatus*, and *torreyi* have been reported for Hamilton county; in Prof. Wright's catalogue for Lorain county, I find *balticus*, *tenuis*, and *nodosus*; and in H. L. Jones' catalogue for Licking county *torreyi* and *canadensis*.

NOTES ON THE SELF-PRUNING OF TREES.

JOHN H. SCHAFFNER AND FRED. J. TYLER.

This paper was published in *The Ohio Naturalist*, Vol. I, pp. 29-32, 1901. The authors give a considerable list of woody plants which cut off their own branches by a special process. Among them were: *Populus alba*, *Quercus acuminata*, *Prunus serotina*, *Salix nigra*, and *Ampelopsis cordata*.

SOME DISTRIBUTION NOTES.

F. M. WEBSTER.

By distribution is meant insect distribution, of course, and more especially such as have, or are sure to come within the boundaries of the state within a comparatively short time.

The 12-spotted asparagus beetle, *Crioceris 12-punctata* has overtaken *C. asparagi*, in Ontario, Canada, in the westward march of these species, and we may now confidently look for the former at any time in northeastern Ohio. The imported elm leaf beetle, *Galerucella xanthomelaeana* has been reported from eastern Kentucky, and, therefore, may be expected to appear in the southeastern part of the state in the not distant future.

One of the dung beetles, *Aphodius fossor*, was introduced from Europe into Canada many years ago, and spread southward through New England and to the westward. I have known of its occurrence in northern Ohio for some time, as we have a single specimen from about Wooster. Quite recently Captain W. M. Hill has sent it to me from East Liverpool. The Mediterranean flour moth, *Ephestia kuhniella*, has been reported from Stark county, which is not to be discredited as we have reared it at Wooster from a culinary preparation known as Grano. The Harlequin cabbage bug, *Murgantia histrionica*, which at one time extended northward nearly to Lake Erie, was killed back,

so to speak, to extreme southern Ohio, by the severe winter of two years ago. Last year it was not reported as present at all, but we found a few of them breeding in Clermont county. This year it is coming to the front again in the extreme south, attacking cabbage in Clermont county and rape in Gallia county.

For eight years I have been searching about Wooster for *Diabrotica longicornis*, not only myself, but I have had every assistant in my department looking for them during their season of occurrence, but without a single individual having been observed. Last summer one lone beetle was found on the blossom of the common sunflower, in my garden. We may look for it in abundance within a few years. It was about twenty-five years ago, in northern Illinois, when I found my first specimen in a corn field. It was a rare find in that locality at that time, but now they may be found there by the million. A small hymenopterous parasite of the San José scale, *Aphelinus fuscipennis*, has been found in Ohio this year for the first time. A single pupa was found by my assistant, Mr. Burgess, in the body of a partly developed scale from Dayton.

ADDITIONS TO THE LIST OF OHIO HEMIPTERA.

HERBERT OSBORN.

- Scolops denticatus* Uh.(?). Bellaire, Aug. 28, 1900.
Liburnia campestris Van D. Bellaire, Aug. 28, 1900.
Liburnia ornata Stal. Bellaire. Common. Aug. 28, 1900.
Clastoptera xanthocephala Germ. Bellaire, Aug. 28, 1900. More common south.
Idiocerus pallidus Fh. Bellaire, Aug. 28, 1900.
Tettigonia hartii Wdw. (MS). Bellaire, Aug. 28, 1900.
Gypona pectoralis Spang. Vinton (Hine).
Xestocephalus tessellatus VanD. Bellaire, Aug. 28, 1900.
Deltocephalus obtectus O. & B. Bellaire, Aug. 29, 1900.
Deltocephalus melsheimeri Fh. Castalia.
Deltocephalus apicatus Osb. Bellaire, Aug. 29, 1900. The most western point yet noted for this species, which has been found in Vermont, New Jersey, Maryland and District of Columbia.
Athysanella acuticauda Bak. Bellaire, Aug. 29, 1900.
Lonatura catalina O. & B. Bellaire, Aug. 29, 1900. The most eastern record for this species, which abounds on *Sporobulus* on the western prairies.
Phlepsius decorus O. & B. Bellaire, Sept. 1, 1900. Also a western species. This Bellaire example was taken on grass surrounding a small spring on a hillside.
Phlepsius fulvidorsum Fh. Vinton, May 5-12, 1900 (Hine).
Thamnotettix inornata VanD. Columbus, Sept., 1900. One example collected by Prof. E. D. Ball.
Cicadula punctifrons Fall. The typical european form. Bellaire, Aug. 20, 1900.
Gnathodus abdominalis VanD. Bellaire, Aug. 29, 1900.
Empoasca smaragdula Fall. Bellaire, Aug. 29-30, 1900.
Empoasca obtusa-trifasciata Gill.
Dicranura flavipennis Wooster (Webster) Bellaire.
Typhlocyba comes-siczac Walsh. Bellaire, Aug., 1900.
Typhlocyba tricolor Fh. Bellaire, Aug., 1900.
Calophya nigripennis Riley. On sumac at Sugar Grove.
Pemphigus populi-transversus Riley. Bellaire, Aug. 31, 1900.
Schizoneura ulmi. Columbus. On red elm.
Chionaspis salicis Harr. On willows. Bellaire, Aug. 31, 1900.
Aspidiotus rapax Comst. Columbus in greenhouse. (Collected by W. F. Naret.)
Melanaethus robustus Uhl. Bellaire, Aug. 29, 1900.
Rhacognathus americanus Stal. Loudonville, June 14, 1900 (Hine).

- Geocoris fuliginosus* Say. Columbus. Bellaire.
Lygaeus reclinatus Say. Sandusky. Bellaire.
Megalocoerea debilis. Uh.
Phytocoris scrupeus Say.
Compsocerochoris annulicornis. Reut. Bellaire.
Lygus invitatus Say. Newark. Ashtabula.
Lygus plagiatus Uh. A western species.
Lygus monachus Uh. Columbus.
Poecyloscytus basalis Reut. Bellaire. Vinton.
Coccobaphes sanguinarius Uhl. Vinton, May 5-12, 1900 (Hine).
Mimiceps gracilis Uh. Sandusky.
Camptobrochis nebulosus Uh. Bellaire, Aug., 1900.
Eccritotarsus elegans Uh. Bellaire, Aug., 1900.
Episcopus ornatus Uh. Celina, Bellaire.
Ilnacora stalii Reut. Bellaire, Aug., 1900.
Ilnacora malina Uh. Vinton, May 1900 (Hine).
Malacocoris irroratus Say. Bellaire, Aug., 1900.
Stiprhosoma stygica Say. Bellaire, Aug., 1900.
Idolocoris agilis Uh. Vinton, May 5-12, 1900 (Hine).
Plagiognathus obscurus Uh. Bellaire, Aug., 1900.
Plagionathus sp. Bellaire, Aug., 1900.
Agalliates associatus Uh. Bellaire. A very common and wide-spread species.
Neoborus lactus Uh. Bellaire, Aug., 1900.
Neoborus pettiti Uh. (MS.). Newark.
Aradus crenatus Say.
Sinea spinipes H. Schf.
Ectrichodia cruciata Say. Vinton. Common south.
Salda. Sandusky Bay. On a wreck about a mile from land. Aug., 1900.
Pelocoris femorata. Dredged from Black Channel, Sandusky Bay.
Corisa bivittata Prov. Dredged from shallow water, sandy bottom, off Cedar Point beach, Lake Erie.
Corisa calva Say. Columbus.

NOTES ON PLANTS FOR 1900.

A. D. SELBY, WOOSTER, OHIO.

In the course of each year new plants or interesting observations are recorded by one situated as is an Experiment Station Botanist. These, to be sure, are sometimes more numerous, sometimes fewer, as well as of varying importance. A good many matters are contributed by correspondents of the Station. For the year 1900 these matters assume about the usual range and variety. They are offered here as possessing possible interest to the members of the Academy.

The following notes relate to phanerogamic plants, which appear for the most part to be unrecorded:

Potamogeton Nutallii, Cham. & Sch.

Doner's Lake, Wayne county, 1899. A. D. Selby.

Carex conoidea, Schkr.

A broad-leaved sort for which the varietal name *latifolia* is suggested. Collected at Gypsum, Ottawa county, O., 1896, by J. C. Britton.

Quercus alba $\times$ *imbricaria*?

A single tree of small size, at Lakeville, Holmes county, O., with pronounced aspect of *Q. alba*, save in the elongated, short-lobed leaves, which obviously approach those of *Q. imbricaria*; of the latter there are typical trees closely adjacent. While midsummer specimens in 1900 show an abundance of very small acorns no mature fruit could be found. Upon some leaf specimens there is a narrowed, elongated basal portion which is very striking. Although certain resemblances to *Q. acuminata* may suggest themselves, this species has not been observed in the immediate region.

Erysimum repandum L.

This species, which we may call "spreading mustard," has been abundantly introduced apparently in seeds of red clover on a farm near Zanesfield, Logan county, Ohio. Ohio is thought by Lyster H. Dewey, to whom I am under obligations for the determination in the first instance, to be the third state of the Union to be credited with this mustard, native in the eastern Mediterranean region. It was collected near Philadelphia in 1877 as a ballast weed; again at South Bethlehem, Pa., in 1892 (?), and at Long Pine, Nebraska, in 1898. Specimens at Zanesfield were freely collected by the writer, June 16, 1900.

Lespedeza angustifolia (Pursh) Ell.

Sand soil, Neapolis, Fulton county, 1899. Lewis Schultz.

Orobanche ramosa L. (?)

On roots of tobacco, Neville, Clermont county. Some features of the imperfect specimens collected after frost, point to *O. Ludoviciana* Nutt., which, however, so far as I know, has not been reported on tobacco.

Gerardia Besseyana Burgess.

Wooster, O., 1899, J. W. T. Duvel.

Aster roscidus Burgess.*Aster undulatus* L.

Both on dry soils.

Wayne county, 1899, Selby and Duvel.

Neapolis, Fulton county, 1900, Selby.

Lactuca Canadensis L.

A striking variety, as it appears to the writer, characterized by the elongated naked stem below the inflorescence. The *var. nudata* is proposed for it. Williams county, 1899, Selby.

Lactuca saligna L.

While still unlisted in the most recent state lists of plants or supplements is an abundant weed of pestiferous character in the southern portions of Dayton, Ohio, and along the Cincinnati pike for several miles from that city. Collected by Selby.

Hieracium Greenii, Porter & Britton.

Specimens of this from Wayne county, 1899. Collected by Selby and Duvel. Habitat, dry soil.

REPORT FOR 1900 ON THE STATE HERBARIUM,
INCLUDING ADDITIONS TO THE STATE
PLANT LIST.

W. A. KELLERMAN.

At the previous annual meeting (Dec., 1899), a brief report was made on the State Herbarium, which was published in the Eighth Annual Report of the Academy, p. 43. This therefore is the Second Annual Report presented and covers the work mainly of 1899 rather than of 1900. Most of the material collected during the present season has not yet been incorporated into the Herbarium, but will in the main be mounted before another collecting season opens. Nearly all of the additions to the State Plant List, however, can be presented to date. The following list indicates both the collectors, and the number of specimens furnished by each that have been incorporated into the State Herbarium since the previous report was made.

Aiken, Walter H.....	71	Fullmer, E. L.....	136
Bogue, E. E.....	1	Goodrich, Miss Sara F...	2
Bonser, Thos A.....	86	Gould, D. T.....	6
Brockett, Ruth E.....	1	Hacker, Otto	3
Burr, Harriet	1	Harnar, Anna	1
Clayton, W. M.....	11	Herrick, C. J.....	3
Davis, J. W.....	1	Herzer, H.	2
Day, Miss M. E.....	1	Hoffman, A. S.....	4
Detmers, Miss Freda....	1	Hopkins, L. S.	1
Drushel, J. A.....	33	Hurm, L.	1

James, Jos F.....	13	Ricksecker, A. E.....	356
James, Jos. F.....	13	Riddle, Lumina Cotton...	38
Jasper, H.	1	Rood, A. N.....	10
Jennings, O. E.....	51	Sanford, J. A.....	18
Kellerman, W. A.....	1,574	Schaffner, J. H.....	4
Kellerman, W. A. & Mrs.	7	Selby, A. D. and Persing,	
Kellerman, W. A. & Beat-		H. L.	2
tie, W. R.....	25	Sharp, Mrs. K. D.....	142
Kellerman, W. A. & Ful-		Shull, Geo. H.....	1
mer, E. L.....	46	Snyder, A. H.....	24
Kellerman, W. A. and		Spence, Mrs. E. Jane....	2
Griggs, R. F.....	78	Stockberger, W. W.....	115
Kellerman, W. A. & K. F.	86	Tangeman, Clara M.....	50
Kellerman, W. A. & K. F.,		Targeb, Walter	1
and Beattie, W. R.....	12	Thomson, Miss Frances E.	4
Kellerman, W. A. & K. F.		Tooil, G. W.....	1
& Jones, Victor.....	30	Tyler, F. J.....	1
Kellerman, W. A. & Tyler,		Vandervort, J. S.....	3
F. J.	11	Walker, F. F.....	2
Kerr, F. P.....	1	Watson, J. R.....	2
Krebs, Wm.	9	Weisman, Laura	1
Lageman, J. H.....	7	Werner, W. C.....	5
Lloyd, C. G.....	2	Wetzstein, A.	195
Louth, E. V.....	38	Wilcox, E. Mead.....	1
McCall, A. G.....	7	Wilkinson, E.	2
McCaun, F. H.....	1	Williamson, E. B.....	25
Miner, C. A.....	19	Winkler, H.	12
Nettleton, A. W.....	6	Young, W. Y.....	3
Osburn, R. C.....	18		
Painter, Walter	1	Total	3,400

It will be seen that 3,400 specimens have been added. The previous list was 9,612; the total is, therefore, 13,012 sheets of specimens. The work of critically examining material and mounting specimens is now being carried on rapidly and possibly 15,000 or 16,000 will more nearly represent the actual number of mounted sheets at the time this report will have been printed.

The Fourth State Catalogue of Ohio Plants contains the list of plants of our Flora known in January, 1899. In April, 1900, the First Annual Supplement to the above was published, and enumerated nearly 70 additions to the previous list. In the *Ohio Naturalist*, 1:15, Nov., 1900, 22

additions were reported. In the same journal (p. 59) ,Feb., 1901—delay in printing this report enables me to include these additions—12 more were given. Below are given all these additions; hence the Fourth State Catalogue with the list given below represents the full state plant list to date. It should be remarked that the additions are unusually large because many of the cultivated plants, known for a long time to have escaped, were not before listed, though they really belonged to our flora.

Aesculus hippocastanum L. Horse Chestnut. Rarely escaped.

Allionia hirsuta Ph. (*Oxybaphus hirsutus* Choisy.) Hairy Umbrella-wort. Ashtabula Co. (E. V. Louth.)

Allium cepa L. Onion. Rarely escaped.

Althaea rosea Cav. Hollyhock. Escaped here and there.

Ampelopsis cordata Michx. Scioto county. W. A. Kellerman.

Antirrhinum majus L. Snapdragon. Sometimes escaped.

Apium petroselinum L. Garden Parsley. Rarely escaped.

Apocynum pubescens R. Br. Velvet Dogbane. Harrison and Auglaize counties. (W. A. & K. F. Kellerman and A. Wetzstein.)

Artemisia caudata Mx. Tall Wormwood. Cedar Point. Erie Co. (San. Fl.—Moseley.)

Artemisia pontica L. Roman Wormwood. Portage Co. (Wm. Krebs.)

Avena sativa L. Common Oat. Escaped generally.

Barbarea stricta Androy. Erect Winter-cress. Escaped in Cuyahoga Co. (L. D. Stair.)

Bellis perennis L. English Daisy. Rarely escaped.

Berberis aquifolium. Pursh. (*Mahonia aquifolium* Nutt.) Seeding in Cemetery, Worthington. R. F. Griggs.

Betula alba pendula Hortorum. Pendulous White Birch. Escaped; Painesville. (Otto Hacker.)

Borago officinalis L. Borage. Escaped at Cleveland. (L. D. Stair.)

Bouteloua hirsuta Lag. Hairy Mesquite-grass. Ohio State University Campus, Columbus. F. J. Tyler.

Bouteloua oligostachya (Nutt.) Torr. Mesquite-grass. Ohio State University Campus, Columbus. Alice Dufour.

Brassica juncea (L.) Cosson. Indian Mustard. Norwalk. (L. D. Stair.)

Brassica napus L. Rape. Rarely escaped.

Bromus asper Murr. Hairy Brome-grass. (London, Mrs. K. D. Sharp; E. Monroe, Highland Co., W. A. Kellerman.)

Bromus breviaristatus (Hook). Buckl. Short-awned Chess. Ashtabula (W. A. Kellerman).

Bromus brizaeformis Fisch & Mey. Cuyahoga Co. (L. D. Stair.)

Calendula officinalis L. Marigold. Rarely escaped.

Callistephus chinensis (L.) Cass. (C. hortensis.) China Aster. Escaped at Sandusky. (W. A. Kellerman.)

Citrullus citrullus (L.) Karst. (C. vulgaris L.) Watermelon. Here and there escaped.

Cleome spinosa L. Spider-flower. Escaped at Cleveland. (L. D. Stair.)

Clinopodium nepeta (L.) Kuntze. (Calamintha nepeta Link.) Field Balm. Escaped. (A. D. Selby.)

Convolvulus japonicus Thumb. Occasionally escaped.

Crataegus cordata (Mill.) Ait. Washington Thorn. Steubenville, Ohio. H. N. Mertz.

Crataegus multiplex n. sp. (W. W. Ashe in Bulletin 175 N. C. Experiment Station, August, 1900.) Ohio, E. E. Bogue, Coll.

Crataegus polybracteata Mx. "Ohio." (W. W. Ashe.)

Cucumis melo L. Muskmelon. Rarely escaped.

Cucumis sativus L. Cucumber. Rarely escaped.

- Cucurbita maxima* L. Squash. Rarely escaped.
- Cucurbita pepo* L. Pumpkin. Rarely escaped.
- Cucurbita pepo ovifera* L. Gourd. Occasionally escaped.
- Cymbalaria cymbalaria* (L.) Wett. (*Linaria cymbalaria* Mill.) Kenilworth Ivy. Escaped here and there.
- Dianthus barbatus* L. Sweet William. Escaped at Cleveland. (L. D. Stair.)
- Dianthus deltoides* L. Maiden Pink. Escaped; Painesville. (Otto Hacker.)
- Diploxys muralis* (L.) DC. Diplotaxis. Cleveland, Ohio. Wm. Krebs.
- Doellingeria infirma* (Mx.) Greene. (*Aster infirmus* Mx.) Cornel-leaf Aster. Portage Co. (Wm. Krebs.)
- Dolichos lablab* L. Hyacinth Bean. Escaped from cultivation in several places in Columbus. Found growing on vacant lots, surrounded by large weeds. John H. Schaffner.
- Duchesnea indica* (Andr.) Focke. Indian Strawberry. Cleveland. (L. D. Stair.)
- Erysimum repandum* L. Logan county. (A. D. Selby in report before Ohio Academy of Science, December 27, 1900.)
- Euphorbia lathyris* L. Pomeroy, Meigs County. W. A. Kellerman.
- Gaura parviflora* Doug. Small-flowered Gaura. A waif at Canton. (A. E. Ricksecker.)
- Gerardia besseyana* Britt. (*G. tenuifolia* var. *macrophylla* Benth.) Bessey's Gerardia. Wooster. (J. W. T. Duvel; reported by A. D. Selby at meeting of the Ohio Academy of Science, December 27, 1900.)
- Gerardia paupercula* (Gr.) Britt. (*G. purpurea* var. *paupercula*.) Erie and Ottawa counties. (San. Fl.—Moseley.)
- Geum macrophyllum* Willd. Large-leaf Avens. Tuscarawas Co. (W. A. & K. F. Kellerman.)

- Gilia coronopifolia* Pers. Growing in a cemetery near Madison, Lake County. Spreading slowly. F. J. Tyler.
- Gyrostachys romanzoffiana* (Cham.) MacM. (*Spiranthus romanzoffiana*.) Hooded Ladies-Tresses. Ashtabula Co. (E. V. Louth.)
- Helianthus petiolaris* Nutt. Prairie Sunflower. Cuyahoga Co. (Wm. Krebs.)
- Helianthus maximiliani* Schrad. Sandusky. A single plant along railroad tracks. R. F. Griggs.
- Hieracium greenii* Porter & Britt. Green's Hawkweed. Wayne County. (Selby and Duvel; reported by A. D. Selby before meeting of Academy of Science, December 27, 1900.)
- Iberis umbellata* L. Candy-tuft. Rarely escaped.
- Iris hexagona* Walt. Southern Blue-Flag. Auglaize Co. (A. Wetzstein.)
- Juncus dichotoma* Ell. Forked Rush. Cuyahoga County. (Edo Claasen.)
- Lactuca saligna* L. European Wild Lettuce. Dayton. (A. D. Selby.)
- Lactuca sativa* L. Garden Lettuce. Rarely escaped.
- Lechea leggettiana* Britt & Hol. Erie Co. (San. Fl.—Moseley.)
- Lechea minor* L. Steubenville, Ohio. H. N. Mertz.
- Leontodon hastilis* L. Dandelion. Escaped; Painesville, Lake County. (Otto Hacker.)
- Lespedeza angustifolia* (Ph.) L. (*L. capitata* var. *angustifolia* Ph.) Narrow-leaf Bush-clover. Fulton county. (A. D. Selby in report at meeting of Ohio Academy of Science, December 27, 1900.)
- Lunaria annua* L. Honesty. Rarely escaped.
- Lycopersicon lycopersicon* (L.) Karst. Tomato. Often escaped.
- Matthiola annua* Sweet. Tenweek-stock. Rarely escaped.

- Medicago denticulata* L. Occasionally escaped. (A. D. Selby.)
- Nicotiana rustica* L. Wild Tobacco. Rarely escaped.
- Nicotiana tabacum* L. Tobacco. Rarely escaped.
- Oenothera rhombipetala* Nutt. Erie Co. (San. Fl.—Moseley.)
- Philadelphus inodorus* L. Mt. Pleasant, Jefferson County. W. A. Kellerman. Sandusky. (San. Fl.—Moseley.)
- Physalis heterophylla ambigua* (Gr.) Ryd. Marblehead, Ottawa Co. (San. Fl.—Moseley.)
- Physalis heterophylla nyctaginea* (Dun.) Ryd. Erie Co. (San. Fl.—Moseley.)
- Polygonum lepathifolium nodosum* (Pers.) Small. Auglaize Co. (A. Wetzstein.)
- Polygonum succarinii* Small. (*P. cuspidatum* Sub. & Zucc.) Japanese Knotweed. Portage Co. (Wm. Krebs.)
- Polymnia canadensis* var. *radiata* Gray. Cedar Point. Very abundant. R. F. Griggs.
- Potamogeton nuttallii* Cham. & Schw., Nuttall's Pondweed. Donor's Lake, Wayne County, Ohio. (Reported by A. D. Selby before meeting of Ohio Academy of Science, December 27, 1900.)
- Prunus angustifolia* Mx. (*P. chicensis* Mx. Hog Plum.) Ross Co. (A. D. Selby.)
- Prunus cerasus* L. Sour Cherry. Sometimes escaped.
- Quercus texana* Buckley. Texas Red Oak. Columbus. (W. A. Kellerman and R. F. Griggs.)
- Ratibida columnaris* (Sims.) Don. (*Lepachys columnaris* T. & G.) Longhead Cone-flower. A waif at Columbus. (J. H. Schaffner.)
- Rhamnus caroliniana* Walt. Carolina Buckthorn. Adams and Brown counties. (W. A. Kellerman.)
- Rhamnus cathartica* L. Buckthorn. Greene Co. (L. D. Hopkins.)

- Rhus cotinus* L. Escaped, Mt. Pleasant, Jefferson Co. W. A. Kellerman.
- Ricinus communis* L. Castor-oil plant. Rarely escaped.
- Rumex patientia* L. Patience Dock. Cedar Point, W. A. Kellerman.)
- Salix candida* x *cordata*. Castalia, Erie Co. R. F. Griggs.
- Salix interior* var. *wheeleri* Rowlee. Cedar Point, W. A. Kellerman and R. F. Griggs.
- Salix nigra* x *amygdaloides*. A. D. Selby, 8th Report Academy of Science, p. 22, and others.
- Salix peltolaris* var. *graciles*. Toledo. (J. A. Sanford, Coll. 1879.) R. F. Griggs.
- Salix sericea* x *cordata*. Ashtabula. (W. A. Kellerman Coll.) R. F. Griggs.
- Sida hermaphrodita* (L.) Rusby. (*S. napaea* Cav.) Virginia Mallow. Fulton Co. (A. D. Selby.)
- Sorbus americana* Marsh. (*Pyrus americana* DC.) American Mountain Ash. Erie Co. (San. Fl.—Moseley.)
- Spinacea oleracea* L. Spinach. Rarely escaped.
- Spiraea prunifolia* Sieb. Bridal-wreath Spiraea. Escaped at Cleveland. (W. A. Kellerman.)
- Syringia vulgaris* L. Lilac. Escaped here and there.
- Taraxacum erythrospermum* Andrez. Red-seeded Dandelion. Lorain Co. (A. E. Ricksecker.)
- Teucrium scorodonia* L. European Germander. Escaped; Painesville, Lake Co. (Otto Hacker.)
- Triticum sativum* Lam. Wheat. Now and then escaped.
- Vaccaria vaccaria* (L.) Britt. (*Saponaria vaccaria* L.) Cow-herb. Lake and Ashtabula counties. (F. J. Tyler and E. V. Louth.)
- Wolffia brasiliensis* Wedd. Brazil Wolffia. Sandusky Bay. Abundant at times. R. F. Griggs.
- Yucca filamentosa* L. Adam's Needle. Escaped in a few places.
- Zea mays* L. Maize. Rarely escaped.

Ohio State Academy of Science

*** *Special Papers No. 4.* ***

The Fishes of Ohio ❧

BY

RAYMOND C. OSBURN, M. Sc.



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with the Emerson McMillin
Research Fund.*



May, 1901



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MAY, 1901.

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1901.

NOTE.

The investigations upon which this paper is based were made under two grants of fifty dollars each from the Emerson McMillin Research Fund, and the results are now published by the further aid of the same fund.

F. M. WEBSTER,
H. C. BEARDSLEE,
WILLIAM R. LAZENBY,
Trustees.

DEDICATION.

*To the memory of my dear friend and teacher, the late
Professor David Simons Kellicott.*

THE FISHES OF OHIO.

An Authenticated List, with Especial Reference to Occurrence
and Distribution.

INTRODUCTION.

THE purpose of this work is to bring together the results of the investigations on the fishes of Ohio, which have from time to time been made in various localities within the state, and to compile an authenticated list of the fishes of Ohio, which shall include only such species as have been definitely reported for the state by some collector. An attempt has also been made to show the distribution in the state, of each species, by citing all the records of occurrence which could be obtained. The results show that many species are so widely distributed and so abundant that they have been taken by every collector in the state; some are widely distributed, but nowhere common; others have been taken commonly in one or two localities, but not elsewhere; and still others are so rare that only single individuals have been recorded.

Before proceeding with the list it may be of interest to glance at the work of some of the collectors of Ohio fishes, as shown by their publications.

The work in the Ohio Valley was begun by C. S. Rafinesque, in a paper dated at Louisville, Kentucky, July 20, 1818. This paper was followed by a number of others in rapid succession, and in December, 1819, to November, 1820, Rafinesque published in a series of articles in the "Western Review and Miscellaneous Magazine," his "Ichthyologia Ohiensis," which, as Dr. Call says, "laid the literary foundation of American Ichthyological Science." As Rafinesque's paper covered the Ohio River System, it is not definitely known how many species he took within the limits of Ohio, but he mentions about twenty-five

species as occurring in the streams of the state, Muskingum, Hocking and Miami Rivers and the Ohio River "as far as Pittsburgh." Rafinesque makes mention of one hundred and eleven species as occurring in the Ohio and its tributaries, but of this number, as Dr. Jordan says, "upwards of forty-three are either spurious or redundant." Of the one hundred and thirty-four native species now recorded for Ohio, Rafinesque described thirty-four. Further comment on Rafinesque's work is unnecessary, as it has been reviewed by various later writers, especially by Dr. Jordan. Dr. R. E. Call has recently published an edition of the *Ichthyologia Ohiensis* in the original text, accompanied by a biographical sketch.

The first paper to appear, dealing entirely with the fishes of the state, was that by Dr. Jared P. Kirtland, published in the Second Annual Report of the Geological Survey of Ohio, and bearing date of November 1, 1838, at Cincinnati. In this paper Dr. Kirtland gave a list of seventy-two species belonging to Ohio. Of this number, at least twelve are redundant. In the "Family Visitor," of 1850, however, Kirtland gave a corrected list, in which seven doubtful species of his former list were omitted, and two other species added, thus reducing his list to sixty-seven species, of which number at least sixty-one are good. Kirtland published other papers on Ohio fishes, his most important work being "Descriptions of the Fishes of Lake Erie, the Ohio River and their Tributaries," which appeared in the "Boston Journal of Natural History," as a serial, in 1840-46. Eight species of our present list were described by Dr. Kirtland, and his careful work resulted in many valuable contributions to ichthyological knowledge.

The next work of importance on Ohio fishes was that of Mr. John H. Klippart, of the State Fish Commission, published in the first and second annual reports of the commission. The first report, for the years 1875-76, contains descriptions of twenty-five species "copied and arranged from the manuscript of Prof. D. S. Jordan, by his assistant, Chas. H. Gilbert," with comments and notes by Klippart, and with plates of nineteen species drawn by Miss Josephine Klippart. The same report also contains a list of one hundred and eighty-five species of fishes "supposed to occur

in Indiana, and therefore in Ohio." In regard to this, Klippart remarks, "Messrs. Jordan and Gilbert's Catalogue of the Fishes of Indiana is here given, under the belief that the same species of fishes found in Indiana south of the watershed may be found in the waters of Ohio." The list contains many species not recorded for Ohio after the lapse of a quarter of a century, and some that, owing to peculiarities of distribution, probably never will be taken. The second report contains descriptions of twenty-four species "arranged from manuscript of Prof. D. S. Jordan, by his assistant, Mr. Ernest Copeland," with plates of sixteen species. As a whole the reports contain much that is good.

By far the most important paper on Ohio fishes is that by Prof. David Starr Jordan, published in the fourth volume of the Report on the Geology of Ohio, entitled a "Report on the Fishes of Ohio," and bearing date of December 10, 1878. Dr. Jordan was at that time connected with Butler University, in Indiana, and his services in the preparation of the report were engaged by Prof. J. S. Newberry, the State Geologist of Ohio. This report contains, besides the synonymy and many valuable notes in regard to habits, careful descriptions of a hundred and sixty-five species of fishes supposed to occur in Ohio. Of this number, nine have since proved to be redundant, while three others have been reduced to varietal rank. Of the remaining number described, more than fifty had not at that time been taken within the limits of the state, but were included because their range was such as made their occurrence within the state probable. Many of these have since been noted, but at the time of publication of Jordan's Report only about one hundred species had been recorded for the state.

Following Jordan's Report, in more recent years have appeared a number of papers dealing with investigations more local in their nature, but all contributing materially to our knowledge of the occurrence and distribution of Ohio species. The first of these of which I have any knowledge, appeared in the Journal of the Cincinnati Society of Natural History, for July-October, 1888, under the title, "Contributions to the Ichthyology of Ohio, No. 1," by Dr. J. A. Henshall, and gave a list, with occurrence notes, of seventy species noted in Hamilton County.

This was followed in January, 1889, by a second paper, more general in its nature, adding forty species noted at various points in the state, and making a state list of a hundred and ten species noted by himself. Localities were given for all the species mentioned.

In 1892 appeared "A Descriptive List of the fishes of Lorain County, Ohio," as "Laboratory Bulletin No. 2," of Oberlin College, by Mr. L. M. McCormick. This list includes eighty-eight species "resting upon specimens preserved in the museum," with brief descriptions, and notes on occurrence and habits, and with plates of eighteen species.

In 1893, Dr. Philip H. Kirsch, at that time Fish Commissioner of Indiana, investigated the Maumee River and its tributaries, under the direction of the U. S. Commission of Fish and Fisheries. Kirsch's paper, "Report upon Investigations in the Maumee River Basin During the Summer of 1893" (Bull. U. S. Fish Com., 1894), includes a list of eighty-seven species of fishes, with descriptions of the streams and lakes of the system, and many interesting notes. The report includes the unpublished notes of a small collection of fishes made in Defiance County by Prof. S. E. Meek, in 1887. Although the investigations covered portions of the Maumee Basin in Indiana and Michigan as well as in Ohio, the occurrences for each locality are definitely noted, and eighty-two of the eighty-seven species mentioned by Kirsch are recorded for localities in Ohio.

In the summer of 1897, Mr. E. B. Williamson and the writer investigated the streams of Franklin County, and published the results in a paper entitled "A List of the Fishes of Franklin County, Ohio, with a description of a new species of *Etheostoma*, by R. C. Osburn and E. B. Williamson" (Sixth Annual Proceedings of the Ohio State Academy of Science, 1898). The list includes sixty-nine species, with occurrence notes, and some color notes on the rarer species, together with many breeding dates, and a table showing distribution.

A somewhat similar investigation was carried on in the summer of 1898, by Messrs. J. B. Parker, E. B. Williamson and the writer, and the results appeared in the Seventh Annual Proceedings of the Ohio State Academy of Science, 1899, under the title,

"A Descriptive List of the Fishes of Big Jelloway Creek, Knox County, Ohio." Many color descriptions of species in high breeding coloration are given, and some interesting breeding and occurrence notes.

Prof. E. B. Williamson has kindly furnished the author with an unpublished list of twenty-six species taken by him in the vicinity of Salem, Columbiana County.

During the summers of 1899 and 1900, aided by a portion of the Emerson McMillin fund of the Ohio Academy of Science, the writer was enabled to investigate some parts of the state not before studied, and, as the general distribution of the food fishes was already quite well known, attention was turned more directly to the smaller and less conspicuous species. As a result of the investigation, several species not previously noted have been added to the list for the state, and a number of rare species recorded for new localities and their range extended, while the knowledge of the distribution of many of the more common species in the state has been considerably furthered. Ten days spent in the vicinity of Ironton, seining in the Ohio River and Ice Creek, a small tributary of the Ohio, and in Johns Creek, a tributary of Symmes Creek, gave some interesting results. The Ohio River, with its tributaries, Wheeling Creek and McMahon Creek, was also seined in the vicinity of Bellaire. The shallow waters of Sandusky Bay were hauled in many places and *Notropis heterodon* was added to the state list. The Huron River, with one of its small tributaries, was seined in the vicinity of Milan, and fifty species, nearly all common, were taken. Ashtabula Creek, in Ashtabula County, was seined, but yielded only a meager list, due to the fact that the stream flows for nearly its whole course over a solid shale bottom. The small streams forming the headwaters of the Wabash River, in Mercer County, yielded a good representative list, forty-nine species being taken. Stillwater and Wolf Creeks, tributaries of the Miami, near Dayton, were hauled, and *Exoglossum maxillingua* taken—a most unexpected find. The Cuyahoga River and its tributary, Break-neck Creek, were seined near Kent, and the Cuyahoga again at Hawkins; Grand River, with its small tributaries, was hauled for some distance above Painesville, and the Chagrin River was

touched at Willoughby ; Chippewa Lake, near Medina ; Summit Lake, at Akron, and Pippin Lake, near Kent, were investigated, and some time was also spent at Buckeye Lake, better known as the Licking Reservoir ; and the North Fork of Licking River, with some of its small tributary streams, was seined near Newark. The results of these investigations will be found embodied in the occurrence notes of the following list.

No attempt was made to collect the parasites of fishes, but in a few cases these were common enough to attract the attention of even the casual observer. In Ashtabula Creek a species of leech was found attacking the catfish. The largest of the leeches were about one and one-half inches in length. They were found usually attached to the lower jaw among the barbels, which in color they closely resembled. Not a catfish was taken in this stream but what bore the evidence of the work of this parasite, and frequently a half dozen leeches would be found on a single small catfish. In the headwaters of the Wabash River, in Mercer County, a species of crustaceous parasite was found in great numbers attacking especially the suckers and minnows. So numerous were they that it was difficult to find individuals of *Catostomus commersonii* and *Camptostoma anomalum*, the species most affected, without at least one of these parasites. The points of attack were chiefly the regions immediately behind the pectoral and ventral fins, probably because they were most protected in such position. A Myxosporid parasite attacking *Notropis cornutus* was noted for a number of localities in central and northern Ohio. This species has been partially described by Linton (Psorosperm of *Notropis megalops* [*cornutus*], Linton, Bull. U. S. Fish Com. for 1889 (1891), IX, pp. 459-61, pl. 120, figs. 1-3), from specimens taken by Mr. L. M. McCormick, in Black River, Lorain County, September 1, 1890, and again on October 5, 1891 ; and Gurley mentions it with additional notes ("The Myxosporidia or Psorosperms of Fishes," by R. R. Gurley, Report of the Commissioner of Fish and Fisheries for 1892 (1894), 12. Genus et sp. incert., pp. 182-3, pl. 7, figs. 1-3). This Psorosperm has been noted by the writer on *N. cornutus* from Franklin County, and from Licking Reservoir in the Ohio River drainage, and from Huron River, Cuyahoga River, Grand River, and Chagrin River,

tributary to Lake Erie. The species is evidently not, as believed by McCormick, "restricted to a very narrow geographical range." The cysts formed by this parasite reproducing in the subcutaneous tissue may reach a diameter of one-third inch, and as many as eleven cysts have been noted on a single fish. It would seem that in some cases they must inevitably cause the death of the host.

Specimens of all the species of fishes recorded by Kellicott, Williamson, Parker and the writer are deposited in the museum of the Ohio State University.

In the preparation of this paper free use has been made of the works of the various writers on Ohio fishes, of "The Fishes of North and Middle America" (Bulletin 47, U. S. National Museum), by Drs. David Starr Jordan and Barton W. Evermann; of Dr. O. P. Hay's "Lampreys and Fishes of Indiana" (19th Annual Geol. Rept. of Ind.), and of the reports and bulletins of the U. S. Commission of Fish and Fisheries. The classification is that adopted by Jordan and Evermann in Bulletin 47, U. S. Natl. Mus. The keys for the separation of families, genera and species have, for the most part, been taken from the same work, but modified and abridged to meet the requirements of the more limited scope of this paper. The descriptions have been drawn largely from the same source, but as far as possible these have been verified for Ohio specimens, and modified as occasion demanded to make them apply more closely to the species as found in Ohio.

While it is not the purpose to discuss in this paper the general anatomy of the fish, such as may be found in any good laboratory guide on zoology, a few hints to the beginner in regard to methods of procedure and to some particular points of structure may here find a place. The teeth in some species are borne on nearly all parts of the mouth and pharynx—premaxillaries, maxillaries, mandibles, vomer, palatines, tongue, hyoid apparatus, pterygoids and pharyngeals, but may be wanting from any or all of them. The examination of all but the last mentioned can usually be satisfactorily made through the open mouth by using a blunt dissecting needle or the head of a pin as a "feeler." It is the determination of the number and arrange-

ment of the lower pharyngeal teeth that constitutes the particular "bête noire" of the uninitiated, but this must be mastered or many identifications will be impossible. The lower pharyngeal bones form the fifth pair of gill arches and usually bear teeth on their inner surfaces, and to examine these it is necessary to remove the bones. This is most easily done in the case of the minnows and other small species by lifting the opercle and inserting a small hook behind the gills. In the sunfish and suckers and other larger forms it is best to run a scalpel around them before attempting to remove them. The teeth when removed are usually covered, more or less, with broken tissues, which can be removed by cleaning carefully with a fine-pointed needle, or with a soft brush under water. In case the teeth have been broken off, as frequently happens, the bases can be distinguished. A good hand lens is essential. In native minnows the pharyngeal teeth are in one or two rows, and their number and arrangement is expressed by a formula—thus 1,4-4, 2, meaning that on one side the small, inner row consists of one tooth, and on the opposite of two, while the teeth of the outer row are the same on both sides. The fins are composed of stout spines, or soft rays or of both. In the fin formula the number of spines is expressed by Roman characters, and the rays by the Arabic figures. Thus the formula, "D. X, 14," indicates that the dorsal fin is composed of ten spines and fourteen rays. If the dorsal fin were in two parts the formula would read "D. X-14." In counting the number of rays the undeveloped rudimentary ones are not usually considered except in the case of the catfish. A little allowance may be made for variation in number of rays. In small specimens where the rays are not always easy to count, a good way to determine the number is to draw the point of a pin forward over the fin near the base of the rays. A good lens is also useful. The dorsal fin is usually referred to in descriptions as simply the dorsal, and other fins in like manner. They are further abbreviated by using D., A., C., V. and P. to stand for dorsal, anal, caudal, ventral and pectoral fins respectively. The scales are counted along the lateral line (a longitudinal row of scales each with a small pore in most fishes) from behind the opercle to the base of the caudal fin, and the transverse rows are counted from the front

of the dorsal fin to the lateral line and from the lateral line to the middle of the belly. Thus the formula, "6-45-4," means that there are forty-five scales in a longitudinal row, and that there are six rows above the lateral line and four below it. If the lateral line were absent the formula would read, "45-10." Variations, sometimes considerable, may be looked for in the scale formula. The gill membranes (free folds of skin below the opercles, supported by one or more branchiostegal rays) may be "connected," that is, united together in a fold below the "isthmus" or space between the throat and breast, they may be "joined to the isthmus" along their lower edges, or they may be "free" from the isthmus and from each other. The pre-maxillaries are "protractile" when they are separated in front from the skin of the forehead by a transverse groove, and "not protractile" when such transverse groove is incomplete or wanting. In some fishes, as in the bass and many sunfishes there is a "supplemental maxillary" bone lying along the upper side of the maxillary. In taking body measurements the depth is taken at the deepest place, and the head is measured from point of snout to the end of the opercle, except that in sunfishes the soft flap is not measured. Depth and length of head are compared with the length of the whole body exclusive of the caudal fin. Thus, "head 4" means that the length of the head is contained four times in the length of the body. The eye is measured to the full width of the orbit.

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THE FISHES OF OHIO.*

- A. Body long and slender, eel-like; skin smooth and slippery, wholly devoid of scales; no paired fins; no lower jaw; the mouth placed in or near the center of a large, circular and sucker-like disc; a single median nostril; skeleton cartilaginous.—
Class: MARSIPOBRANCHII (Cyclostomes).
- AA. Body variously developed, scales usually but not always present; paired fins present; lower jaw always present; nostrils never median.—
Class: PISCES (True Fishes).

Class: MARSIPOBRANCHII.

Order: HYPEROARTII.

Family: PETROMYZONIDAE (Lampreys).

Key to Genera.

- A. Sucker large, and furnished with numerous teeth which are in rows radiating from the mouth; horny plate above the mouth short and provided with 2 or 3 teeth, which are placed close together.—
ICHTHYOMYZON.
- AA. Sucker relatively small, and with few teeth; mouth overhung with a crescent-shaped, horny plate, which terminates at each end in a distinct tooth; tongue armed in front with a crescentic, serrated, horny plate.—
LAMPETRA.

Genus: ICHTHYOMYZON.

Ichthyomyzon concolor (Kirtland). SILVER LAMPREY.

Sucking disk large, moderately fringed; teeth strong and nearly uniform; two teeth on supraoral plate; seven in the transverse row below mouth, the remaining teeth arranged in about four concentric circles. Dorsal fin arising midway from snout to end of tail, broadly notched, continuous with caudal; anal fin also continuous with caudal. About fifty-two muscular grooves between gills and vent. General color bluish, sometimes blotched with black; a dark blue spot above each gill opening. Length about 12 inches.

This species appears to be distributed throughout the state, though nowhere very common. It ascends small brooks in spring to breed. McCormick mentions finding females with ripe eggs on May 22, in Vermillion river. The breeding date must be considerably earlier in central Ohio, as Messrs. Parker, Williamson and the writer took young larvæ a couple of inches long in Big Jelloway creek, Knox County, during the latter part of May, 1898. On the same date a large larva seven inches long was taken, so the species must continue in the larval stage something

*It has been thought best to include here also the Lampreys (*Marsipobranchii*) of Ohio, for the reason that, in the popular idea, a lamprey is a "fish."

more than a year. One large larva, seven inches in length, showed the following colors: dull yellow, pigmented above with fine, brown specks, giving to the back a brownish cast; this is interrupted in the mid-dorsal line, leaving a yellow, vertebral line; fins yellowish, brightest at base. Young larvæ, two and one-half inches long, were light olive brown, with fine brown specks above; dark around base of anal fin. Eyes very slightly developed. The young larvæ were taken from a mass of sand and mud seined from the bottom of Sawmill Run.

The species was first taken by Dr. Kirtland in Big Miami river, and described by him. He afterward recorded it from the Mahoning and Scioto rivers. Vermillion river, McCormick, 1892; Big Jelloway creek, Parker, Williamson and Osburn, 1898; Henshall mentions one which passed through a hydrant in Cincinnati; and Dr. Jordan says, "I have obtained several specimens with Perch from Lake Erie, both external, feeding on the Perch, and internal, having been devoured by the fish."

Genus: LAMPETRA..

Lampetra wilderi (Gage). SMALL BLACK LAMPREY;
BROOK LAMPREY.

Sucking disk smaller than in the preceding, the fringes longer. Dorsal fin arising midway from snout to end of tail, not continuous with caudal except during breeding season, when it is deeply notched. Below the mouth is a transverse row of blunt, horny teeth, 5 to 9 in number. On each side of the disk is a plate with three bicuspid teeth; supraoral plate with a tooth at either end; remaining teeth few and weak. About 65 muscular grooves between gills and vent. Color bluish black, lighter on disk and belly. Length 6 to 9 inches.

Although from its range we might expect this species to occur throughout the state, it has, I believe, been recorded for but one locality. Mr. J. B. Parker has observed it to be common on the ripples of small tributaries of Big Jelloway creek, in Knox County, about the middle of April. Four specimens were captured at one dip of an insect net, and specimens taken by him are in the State University collection. The *Ammocetes bicolor*, or Blind Lamprey, which Kirtland records from the Mahoning river may have been the larva of either this or the preceding species, as the immature forms are so similar as to be almost indistinguishable.

Class : PISCES.

Sub-Class : TELEOSTOMI (True Fishes).

Artificial Key to the Families of Fishes.

I. VENTRAL FINS PRESENT—ABDOMINAL.

- A. Back with an adipose fin behind the single, rayed dorsal fin.
- B. Head with barbels about mouth and nostrils, body scaleless; a single spine in each pectoral and in dorsal fin.—SILURIDÆ.
- BB. Head without barbels; body scaled.
 - C. Dorsal, anal and ventral fins each with a small but distinct spine; scales ctenoid.—PERCOPSIDÆ.
 - CC. Dorsal, anal, and ventrals without distinct spine; scales not ctenoid.—SALMONIDÆ.
- AA. Back without adipose fin.
 - D. Dorsal fin single, composed of rays, and not preceded by a series of free spines.
 - E. Tail evidently strongly heterocercal.
 - F. Body naked; snout with a spatulate blade; mouth wide, without barbels.—POLYDONTIDÆ.
 - FF. Body with scales or bony plates or shields.
 - G. Body with 5 series of bony shields; mouth inferior, toothless, preceded by four barbels.—ACIPENSERIDÆ.
 - GG. Body scaly.
 - H. Scales cycloid; a broad, bony, gular plate; dorsal fin many rayed.—AMIIDÆ.
 - HH. Scales ganoid; no gular plate; dorsal fin short.—LEPISOSTEIDÆ.
 - EE. Tail not evidently heterocercal.
 - I. Gill membranes broadly joined to the isthmus; head naked; no teeth in jaws.
 - J. Lower pharyngeal teeth very numerous, in one row like the teeth of a comb.—CATOSTOMIDÆ.
 - JJ. Lower pharyngeal teeth few, fewer than 8, in 1 to 3 rows.—CYPRINIDÆ.
 - II. Gill membranes free, not attached to the isthmus.
 - K. Head scaly, more or less.
 - L. Upper jaw not protractile, its lateral margins formed by the maxillaries.
 - M. Jaws depressed, prolonged; lateral line present.—LUCIIDÆ.
 - MM. Jaws short; no lateral line.—UMBRIDÆ.
 - LL. Upper jaw protractile, its margin formed by premaxillaries alone; no lateral line.—POECILIIDÆ.
 - KK. Head naked.
 - N. Lateral line well developed; mouth large, teeth all pointed, some of them canine.—HIODONTIDÆ.
 - NN. Lateral line wanting.
 - O. Mouth small, inferior, toothless; stomach gizzard-like.—DOROSOMATIDÆ.
 - OO. Mouth moderate, terminal; stomach not gizzard-like.—CLUPEIDÆ.

DD. Dorsal fin not as in D.

P. Dorsal fin single, preceded by free spines; body scaleless.—

GASTEROSTEIDÆ.

PP. Dorsal fins, two; the first small, composed entirely of spines; body very slender, covered with scales.—

ATHERINIDÆ.

II. VENTRAL FINS PRESENT—THORACIC OR SUB-JUGULAR.

A. Body covered with scales.

B. Rays of the ventral fins, I, 5.

C. Lateral line extending on caudal fin to tip of middle rays.—SCIAENIDÆ.

CC. Lateral line not extending beyond base of caudal fin.

D. Pseudobranchiæ or false gills on under side of opercles well developed; head scaled forward to between nostrils.—SERRANIDÆ.

DD. Pseudobranchiæ wanting or covered by skin.

E. Anal spines, 3 to 10; body more or less deep and compressed.—

CENTRARCHIDÆ.

EE. Anal spines, 1 or 2; body usually elongate.—

PERCIDÆ.

BB. Rays of the ventral fins not I, 5.

F. Dorsal fin single, with 3 or 4 spines.—

APHREDODERIDÆ.

FF. Dorsal fin divided into 2 distinct parts, spines wanting.—

GADIDÆ.

AA. Body naked; dorsal fin with 6 or 7 spines.—

COTTIDÆ.

III. VENTRAL FINS ENTIRELY WANTING.

A. Body long and snake-like; skin covered with long imbedded scales at right angles to each other; lower jaw projecting.—

ANGUILLIDÆ.

Series: GANOIDEI.

CHONDROGANOIDEA (THE CARTILAGINOUS GANOIDS).

Order: SELACHOSTOMI.

Family: POLYDONTIDÆ.

Genus: POLYODON.

Polyodon spathula (Walbaum). PADDLE-FISH; SPOON-BILL CAT.

A very peculiar looking fish, recognizable at once by its long, paddle-shaped snout, which is about $\frac{1}{3}$ the length of the body and is thin and flexible. The eyes are small and placed near the base of the snout; opercular flap long, reaching back as far as to the ventral fins. Caudal fin large, forked, the lobes about equal. Color olivaceous, paler below. This singular fish attains a length of 5 or 6 feet, but is of little or no economic importance.

Taken in the Ohio and Muskingum rivers, Kirtland; "one was taken in a pound net (in Lake Erie) near Vermillion in 1874," McCormick; "common in the Ohio river," Henshall, 1888.

Order: CHONDROSTEI.*Family:* ACIPENSERIDÆ.*Key to Genera.*

- A. Spiracles present; snout subconic; rows of bony shields distinct throughout; the tail not depressed nor mailed.— ACIPENSER.
 AA. Spiracles obsolete; snout subspatulate; rows of bony shields confluent behind dorsal so that the depressed tail is completely mailed.— SCAPHIRHYNCHUS.

Genus: ACIPENSER.

Acipenser rubicundus Le Sueur. LAKE STURGEON;
OHIO STURGEON; ROCK STURGEON.

Body elongate, terete, tapering towards snout and tail. Snout long and slender in young, becoming more blunt with age. Body covered with large, rough, strongly hooked shields, which become smoother with age. Color dark olive above, sides paler or reddish, with sometimes irregular dark spots. Length 6 feet.

This species occurs both in Lake Erie and the Ohio river. Those from the Ohio, formerly considered as belonging to a separate species, *A. maculosus*, are now regarded as the young of *A. rubicundus*. "The Ohio river as far as Pittsburg," Rafinesque (Rafinesque made six species out of this and *Scaphirhynchus platyrhynchus*, which he included in the same genus); Lake Erie and Ohio river, Kirtland; Lorain County, very common, McCormick, 1892; abundant in the Ohio river, Henshall, 1888; Lake Erie (west end), Kirsch, 1893.

Genus: SCAPHIRHYNCHUS.

Scaphirhynchus platyrhynchus (Rafinesque).
SHOVELNOSE STURGEON.

Body slender, head broad, becoming suddenly broader just behind the eyes. Snout flat and pointed. The body tapers gradually backward from the head to the tail, the upper lobe of which ends in a long, slender filament. Body protected by five rows of bony shields, which are keeled and hooked. Color olive, paler below. Length 5 feet.

"Very common in the Ohio, but seldom reaching as high as Pittsburg," Rafinesque; "common in the waters of the Ohio," Kirtland; "common in the Ohio," Henshall, 1888.

HOLOSTEI (THE BONY GANOIDS).

Order: RHOMBOGANOIDEA.

Family: LEPISOSTEIDÆ.

Genus: LEPISOSTEUS.

Key to Species.

- A. Large teeth of upper jaw in 1 row on each side.
 - B. Beak long and slender, snout more than twice the length of head.— *osseus*.
 - BB. Beak shorter and broader, little longer than the rest of the head.— *platostomus*.
- AA. Large teeth of upper jaw in 2 rows on each side; beak short and broad, not longer than rest of head.— *tristechus*.

Lepisosteus osseus (Linnaeus). COMMON GAR PIKE;
BILLFISH; GAR.

Snout at least twice as long as the rest of the head, and quite slender, its least width being contained 15 or 20 times in its length. Color olivaceous above, paler below. Young with round, black spots on vertical fins and posterior part of body, these becoming less distinct with age. Very young with black, lateral band. Length 5 feet.

A voracious, good-for-nothing fish, but interesting to the naturalist on account of its structure and habits. A common and widely distributed species, being found in Lake Erie and Ohio river, and in all the larger streams of the state. They are very common in the Scioto river below Columbus, where the river in summer is rotten with filth from the sewers of the city. They have a peculiar habit of lying motionless in schools at the top of the water. Dr. Kirtland records the species for the state as "found in most of the larger tributaries of the Ohio;" Lorain County, Lake and lower part of larger streams," McCormick, 1892; Ohio river and Lake Erie, Henshall, 1889; Maumee river, Blanchard river, Auglaize river, Hoaglin creek and Beaver creek, Kirsch, 1893; Scioto river at Columbus, Williamson and Osburn, 1897; Ohio river at Ironton, John's Creek at Waterloo, Huron river at Milan, and Sandusky Bay, R. C. Osburn, 1899; Ohio River at Bellaire, R. C. Osburn, 1900.

Lepisosteus platostomus Rafinesque. SHORT-NOSED GAR.

Distinguished from *L. osseus* chiefly by the snout, which is only a little longer than the rest of the head—never more than $1\frac{1}{4}$ times the length of

the head. The snout is also comparatively broader than in *L. osseus*, its least width being contained only 5 or 6 times in its length. Coloration much as in *L. osseus*.

Rare in Lake Erie and its tributaries, more common in the Ohio and its tributary rivers. Ohio, Miami and Scioto rivers, Rafinesque; Maumee river at Toledo, "a single specimen," Kirsch, 1893; Lorain county, "very rare," McCormick, 1892; Sandusky Bay, one specimen, and Ohio river at Ironton, R. C. Osburn, 1899.

Lepisosteus tristœchus (Bloch and Schneider). ALLIGATOR GAR.

Snout shorter than in either of the preceding members of this genus, being usually shorter than the head. It is also comparatively much broader, its least width being contained in its length $3\frac{1}{2}$ times. Length 8 or 10 feet. "A huge, muscular, voracious fish, useless as food, remarkable for its armature of enameled scales."

This species is included on the authority of Dr. Kirtland, who says (Rept. on the Zool. of Ohio, 1838): "A specimen is to be seen in the Cincinnati Museum, said to have been taken within the bounds of our state." Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) give its range as far as Cincinnati, whether on added evidence I do not know.

Order: CYCLOGANOIDEA.

Family: AMIIDÆ.

Genus: AMIA.

Amia calva Linnaeus. DOGFISH; BOWFIN; GRINDLE.

Head $3\frac{3}{4}$ in length; depth 4 to $4\frac{1}{2}$; D. 48; A. 10 to 12; V. 7; scales in lateral line 67; lateral line nearly median, directed slightly upward at either end. Color dark olive or blackish, paler below; lower jaw usually with round, dark spots; fins somewhat mottled. Male with a round, black spot at base of caudal above, surrounded by a yellowish or orange shade. Length, male 18 inches; female 2 feet.

Lake Erie, Kirtland; Lake Erie and Ohio river, Jordan; Lorain County, "Rare, once in a great while one is brought in from the pounds, and I have taken one in Black river," McCormick, 1892; Lake Erie, Henshall; one specimen from the Maumee river at Toledo, Kirsch, 1893; Huron river and Sandusky Bay, R. C. Osburn, 1899.

*Series: TELEOSTEI.**Order: NEMATOGNATHI.**Family: SILURIDÆ (The Catfishes).**Key to Genera.*

- A. Adipose fin, with its posterior margin free.
- B. Premaxillary band of teeth truncate behind; not produced backward at the outer angles.
 - C. Supraoccipital bone continued backward from the nape, its notched tip receiving the bone at base of dorsal spine, so that a continuous bony bridge is formed under the skin; caudal fin forked.— Ictalurus.
 - CC. Supraoccipital not reaching as far as dorsal fin, the bony bridge more or less incomplete.— Ameiurus.
- BB. Premaxillary band of teeth with a lateral backward extension on each side; lower jaw projecting.— Leptops.
- AA. Adipose fin keel-like, adnate to the back.
 - B. Band of teeth in upper jaw, with a backward extension at its outer posterior angle as in *Leptops*.— Noturus.
 - BB. Band of teeth in upper jaw without backward extension, as in *Ameiurus*.— Schilbeodes.

*Genus: ICTALURUS.**Key to Species.*

- A. Anal fin very long, its rays 32 to 35.— *furcatus*.
- AA. Anal fin shorter, its rays about 26.— *punctatus*.

Ictalurus furcatus (Le Sueur). CHUCKLE-HEADED CAT.

Head $4\frac{1}{2}$; depth 4 in adults to $5\frac{1}{2}$ in young. Anal fin long, of 32 to 35 rays. Eye small, wholly anterior, the middle of the head being behind its posterior margin. Humeral spine not reaching middle of pectoral spine. Color silvery, sometimes spotted with darker. Sometimes reaching a weight of over 40 pounds.

"I have seen one or two specimens taken at Cincinnati," Jordan; "common in the Ohio river," Henshall, 1888. Not recorded elsewhere in the State.

Ictalurus punctatus (Rafinesque). CHANNEL CAT; BLUE CAT;
WHITE CAT; LADY CAT.

Head 4; depth 5; anal fin of 25 to 30 rays, usually 27 in Ohio specimens. Eye large, the middle point of the length of the head being near its posterior margin. Barbels long, those of the maxillary reaching beyond gill opening. Humeral process long, more than $\frac{1}{2}$ the length of pectoral spine. Color light olivaceous, becoming silvery or pale on sides and belly; the sides usually with distinct round, dark spots, these becoming less distinct with age. Young specimens usually have a gaunt, faded-out, "consumptive" look. It reaches a weight of about 25 pounds.

Distributed throughout the state, but more abundant in the Ohio and tributaries. Rafinesque records it under the name *Pimelodus* (*Silurus*) *maculatus*, "as far as Pittsburg." Kirtland mentions it under the name *Pimelobus coerulescens*, as "common to the Ohio and lake waters," and as *P. pallidus*, "common in the Ohio at Cincinnati." The latter is identical with the former. Abundant in Ohio and Little Miami rivers, Henshall, 1888; Lorain County, common, McCormick, 1892; Maumee river at Toledo and Grand Rapids, Kirsch, 1893; Muskingum river at McConnellsville, Prof. D. S. Kellicott, 1895; Franklin County, "common in all larger streams, especially in Big Walnut creek," Williamson and Osburn, 1897; Ohio river and Ice creek at Ironton, Wabash river at Celina, R. C. Osburn, 1899; Chippewa lake, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: AMEIURUS.

Key to Species.

- | | | |
|-----|--|--------------------|
| A. | Caudal fin forked.— | <i>lacustris</i> |
| AA. | Caudal fin not forked. | |
| B. | Anal fin long, of 24 to 27 rays (counting rudiments).— | <i>natalis</i> . |
| BB. | Anal fin shorter, of 17 to 22 rays. | |
| C. | Lower jaw projecting. Anal rays 20.— | <i>vulgaris</i> . |
| CC. | Lower jaw not projecting. | |
| D. | Pectoral spines long, 2 to 2½ in head; anal rays 20 to 23.— | <i>nebulosus</i> . |
| DD. | Pectoral spines shorter, 2½ to 3 in head; anal rays 17 to 19.— | <i>melas</i> . |

Ameiurus lacustris (Walbaum). MISSISSIPPI CAT; GREAT
FORK-TAILED CAT.

Head 4, low, broad and depressed, its upper surface quite flat, its width $\frac{5}{8}$ its length. Depth 5; D. I-5; A. 25 to 32, base of the fin as long as head. Humeral process short, only a little over $\frac{1}{2}$ the length of pectoral spine. Body stouter than in the preceding genus. Caudal fin deeply forked. Color dark olivaceous or slate, growing darker with age; belly pale, no dark spots on sides. Our largest catfish, said to reach a weight of 150 pounds or more.

In Ohio this species is well distributed, being found in the lake, Ohio river and larger streams. Kirtland does not record this species, probably confusing it with his *Pimelobus coerulescens* (*Ictalurus punctatus*). Common in the Ohio river, Henshall, 1888; Lorain County, common in the lake and lower parts of the rivers, McCormick, 1892; Franklin County, two specimens taken in Big Darby creek; one of these, a female weighing 4½ pounds, contained eggs, June 21, 1897, Williamson and Osburn.

***Ameiurus natalis* (Le Sueur). YELLOW CAT.**

Head broad and short; upper jaw slightly projecting. Body stoutish; the back low, not arched. Anal fin long, its base contained in length of body $3\frac{1}{2}$ to $3\frac{1}{4}$ times; its rays 24 to 27. Color usually brownish or yellowish, sometimes black; belly pale or yellowish. Length about a foot. Ohio specimens seem to fall into the nominal variety *cupreus*, as indicated by the longer upper jaw.

This is a common species in most parts of Ohio, occurring in nearly all streams and lakes. "The yellow catfish I have only seen in the Cincinnati markets, where it is comparatively rare," Kirtland; Lake Erie, Henshall, 1889; Lorain County, "common in the ponds, streams and lake," McCormick, 1892; Maumee river at Antwerp, Defiance, Grand Rapids and Waterville, Tiffin river at Brunersburg, Sugar creek at Lima, Lost creek at Lima, Blanchard river at Findlay and Ottawa, Beaver creek at Grand Rapids, "seemingly scarce at all of these points," Kirsch, 1893; Franklin County, Scioto river, Olentangy river, Big Walnut, Little Walnut and Darby creeks, and Hell Branch, Williamson and Osburn, 1897; Ohio river at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Chippewa lake, Summit lake, Licking reservoir, R. C. Osburn, 1900.

***Ameiurus vulgaris* (Thompson). LONG-JAWED CATFISH.**

Head $3\frac{1}{2}$ to 4, a little longer than broad, considerably narrowed forward when viewed from above, lower jaw distinctly projecting. Body somewhat elongate and compressed, the back somewhat elevated. Anal rays 20. Color dark brownish or black, becoming white rather abruptly on the belly. Length 18 inches.

The Long Jawed Catfish is not common in Ohio, but seems to be widely distributed. Jordan mentions it as "taken in Lake Erie and occasionally in the Ohio"; Henshall in 1889 records it for Lake Erie; Lorain County, "Martin's run, only one recorded," McCormick, 1892; two specimens from the Ohio canal at Columbus, Williamson and Osburn, 1897; Pippin lake, R. C. Osburn, 1900.

Ameiurus nebulosus (Le Sueur). COMMON BULL-HEAD;
HORNED POUT.

Head broad and flattened, upper jaw noticeably the longer. Body rather elongate, depth 4 to 4½. Anal fin with 20 to 22 rays, its base contained 4 times in length of body. Humeral process more than ½ the length of the rather long pectoral spine. Color dark brown or brownish yellow, usually somewhat clouded, sometimes nearly black. Length 18 inches.

A very common species in the lake and its tributaries, less common in the Ohio river drainage, but found in all larger streams. "Occasionally seen in the Cincinnati markets," Kirtland; Lake Erie, Henshall, 1889; Lorain County, "common in all streams," McCormick, 1892; Maumee river at Cecil and Waterville, Fish creek at Edgerton, St. Mary's river at St. Mary's, Gordon and Lost creeks near Cecil, Tiffin river at West Unity and Brunersburg, Auglaize river at Wapakoneta, Cloverdale, Oakwood and Defiance, Sugar creek at Cloverdale and Lima, Lost creek at Lima, Blanchard river at Findlay and Cloverdale, Hoaglin creek at Oakland, Kirsch, 1893; Franklin County, Scioto river, Olentangy river, Mason's run, Big Walnut, Little Walnut, Big Darby and Alum creeks, Williamson & Osburn, 1897; Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, R. C. Osburn, 1899; Pippin lake, Summit lake, R. C. Osburn, 1900.

Ameiurus melas (Rafinesque). BLACK BULL-HEAD.

Body stout, short and deep, back high, the profile nearly straight to base of dorsal fin. Head broad, rounded in front, jaws about equal. Pectoral spine short, its length contained 2½ to 3 times in length of head. Anal fin short and deep, its base 4½ to 5 in length of body, rays 17 to 19, the light colored rays contrasting sharply with the dark membranes. Color almost black, sometimes brownish or yellowish, the belly pale or yellowish. This species shares with the three next preceding the name of Bull-head, the ordinary fisherman not drawing very fine distinctions in regard to species.

The Black Bull-head is the most abundant species of catfish in the state, found in nearly all streams and ponds of whatever size, and especially in the Ohio river drainage. It is less abundant in the lake drainage. It is a mud loving species and is less likely to be found in clear, swift streams than in muddy, stagnant bayous. *A. xanthocephalus* Rafinesque is now recorded as synonymous

with *A. melas*. Recorded by Kirtland as *A. xanthocephalus*, and by Jordan as *A. melas* and *xanthocephalus*. "Very common in Ohio and Little Miami rivers and Mill creek," Henshall, 1888; Lorain County, "common in all streams and ponds," McCormick, 1892; Maumee river at Cecil and St. Mary's river at Rockford, Kirsch, 1893; Franklin County, in nearly all streams, Williamson and Osburn, 1897; Big Jelloway creek at Howard, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Sandusky, Prof. D. S. Kellicott, Williamson and Osburn, 1896; Niggermill run at Salem, E. B. Williamson, 1900; Sandusky bay at "Black Channel," Breakneck creek and Cuyahoga river near Kent, and Licking reservoir, R. C. Osburn, 1900; June 22 is given as a breeding date by Williamson and Osburn.

Genus: LEPTOPS.

Leptops olivaris (Rafinesque). MUD CAT.

Body slender, depressed forward, the head extremely flat, the lower jaw the longer. Dorsal spine very weak, only $\frac{1}{2}$ the height of the fin; caudal fin slightly emarginate; anal short, its base about $\frac{1}{3}$ the length of body, its rays 12 to 15. Yellowish, much mottled with brown and greenish, whitish below. Size large, reaching a weight of 50 to 75 pounds.

Jordan says, "This species abounds in the Ohio river and its larger tributaries," but it is probably common nowhere in Ohio except in the southwestern part of the state. Henshall records it for White Oak creek and the Ohio river, 1889; and in 1892 McCormick mentions the occurrence in Lake Erie, Lorain County, as "quite rare; I have seen but one specimen fresh, though I have noticed heads on the beach."

Genus: NOTURUS.

Noturus flavus Rafinesque. YELLOW STONE CAT.

Head broad and flat, much depressed, 4 in length of body. Body terete, tail compressed. Soft dorsal fin keel-like, separated from caudal by a deep notch. Dorsal spine very short, only $\frac{1}{2}$ as long as pectoral spine; caudal rounded; anal short, its rays about 16. Brownish yellow, varying into bluish or blackish. Length 1 foot.

Widely distributed and generally common in suitable localities. It is found most abundantly on stony ripples of the larger streams, and on sandy and gravelly bottoms of rivers and lakes. "Occasionally found beneath stones in the Mahoning river," Kirtland; "much more abundant in the Ohio and its immediate tributaries than in the streams of the interior," Jordan; "abundant in Little Miami river, Mill creek and nearly all streams" (Hamilton County), Henshall, 1888; Lorain County, "larger streams and the lake," McCormick, 1892; Maumee river at Defiance, Grand Rapids and Waterville, Fish creek at Edgerton, St. Mary's river at Rockford, Auglaize river at Cloverdale and Defiance, Blanchard river at Ottawa, Hoaglin creek at Oakland, and Blanchard river and Sugar creek at Cloverdale, Kirsch, 1893; Franklin County, "abundant in all larger streams, Scioto and Olentangy rivers, Big Walnut, Little Walnut, Alum, Big and Little Darby creeks, Black Lick and Hell Branch," Williamson and Osburn, 1897; Knox County, Big Jelloway creek, Parker, Williamson and Osburn, 1858; John's creek at Waterloo, Huron river at Milan, North Fork of Licking river at Newark, R. C. Osburn, 1899; Lake Erie at Sandusky, frequently thrown up dead on the beach by the waves; not noticed in Sandusky bay, Wheeling creek at Bridgeport, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: SCHILBEODES.

Key to Species.

- A. Pectoral spine entire or grooved behind, never retrorsely serrate; adipose fin high and continuous, not separated by a notch from the caudal.— *gyrinus*.
- AA. Pectoral spine distinctly serrate behind.
 - B. Adipose fin nearly or quite free from caudal; color nearly plain brownish, saddle-like blotches faint, everywhere pigmented with fine dots; anterior edge of pectoral spine retrorsely serrate.— *cleuthernus*.
 - BB. Adipose fin not quite free from caudal; color much variegated, back with distinct saddle-like blotches; pectoral spine strong, its anterior edge with few serrations.— *miurus*.

Schilbeodes gyrinus (Mitchill). CHUBBY STONE CAT;
TADPOLE CAT.

Head large, broad and depressed, $3\frac{1}{2}$ to 4 in length; mouth wide, jaws about equal. Body short and stout, pot-bellied, shaped much like a tadpole. Caudal peduncle comparatively long and compressed. Pectoral spine not serrated behind, but grooved instead. Anal fin with 13 rays. Soft dorsal

continuous with caudal, scarcely notched. Color yellowish brown or brownish olive, nearly uniform; a distinct narrow, black line along lateral line. Length 5 inches.

Rather irregularly distributed, but common in suitable localities. Dr. Jordan (Ohio Rept.) says of this species and *S. miurus* that "their habits are similar, they are usually found together and are about equally abundant in Ohio," but in the writer's experience *S. miurus* has been found much more generally distributed, occurring in the open water of streams, usually on gravelly or stony bottom, while *gyrinus* seems to prefer the quiet of lakes and ponds, and in the course of several years collecting the two species have never been taken together. *S. gyrinus* was observed by Prof. D. S. Kellicott, Mr. E. B. Williamson and the writer to be common among the decaying vegetation in shallow water in Sandusky Bay in 1896; "Ross lake," Henshall, 1889; Lorain County, "Common on mud banks in the lower parts of streams entering the lake," McCormick, 1892; Maumee river at Toledo, St. Mary's river at St. Mary's, "everywhere scarce," Kirsch, 1893; Franklin County, Mason's run and Big Darby creek, rare, Williamson and Osburn, 1897; Sandusky Bay, R. C. Osburn, 1899; Summit lake, Licking reservoir, R. C. Osburn, 1900.

***Schilbeodes eleutherus* (Jordan).**

Head broad and flat, much depressed, narrowed anteriorly, $3\frac{3}{4}$ in body; upper jaw much longer than the lower, which is included. Body much of the same form as that of *S. miurus*, but with the back somewhat higher; depth $4\frac{1}{2}$ in length. Soft dorsal free from caudal, or only very slightly connected. Color nearly uniform brown above, lighter below, flecked everywhere except on middle of belly, with black dots. Distinguished from *S. miurus*, which it most nearly resembles, by the free adipose fin, the longer upper jaw and the absence of distinct, black, saddle-like blotches on the back. Length 4 inches.

I know of but one specimen of this very rare species taken within the limits of the state. This was taken in Big Walnut creek, Franklin County, by Mr. E. B. Williamson and the writer, June 25, 1897.

Schilbeodes miurus (Jordan). CROSS-BARRED STONE CAT.

Head very much depressed, rounded anteriorly, $3\frac{3}{4}$ in length; upper jaw longer but not so much so as in the preceding species. Depth about 5 in length; back scarcely elevated; adipose fin connected with caudal, but more or less deeply notched. Conspicuously mottled with gray and blackish, with 3 or 4 definite black blotches across the back. Length, 4 inches.

A rather common and widely distributed species. Ohio river at Raccoon I., Henshall, 1889; Lorain County, quite rare, Vermillion and Black rivers, McCormick, 1892; Maumee river at Antwerp, St. Joseph river at Edgerton, St. Mary's river at Rockford, Tiffin river at West Unity and Brunersburg, and Auglaize river at Cloverdale, Oakwood and Defiance, "In an old mill race which empties into Tiffin river near West Unity large numbers were caught, common in Hoaglin creek near Oakwood, rather scarce at all other points," Kirsch, 1893; Franklin County, generally common, abundant in Big Walnut, taken also in Scioto river, Olentangy river, Black Lick, Little Walnut, Big Darby and Alum creeks, Williamson and Osburn, 1897; Ohio river at Ironton, John's creek at Waterloo, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900. Females were observed with ripe eggs from June 25 to July 6, 1897, by Mr. Williamson and the writer.

Order: PLECTOSPONDYLI.

Sub-Order: EVENTOGNATHI.

Family: CATOSTOMIDÆ (The Suckers).

Key to Genera.

- A. Dorsal fin elongate, developed rays 25 to 50, air bladder in 2 parts.
- B. Fontanelle present, body ovate, scales large.
 - C. Mouth large, more or less terminal, protractile forward; pharyngeal bones and teeth moderate, large species of dark color.— *ICTIOBUS*.
 - CC. Mouth smaller, inferior, protractile downward; pharyngeal bones narrow, the teeth thin and weak; smaller species, pale in color.— *CARPIODES*.
- BB. Fontanelle obliterated by union of parietal bones; body elongate; scales rather small; lips thick and papillose.— *CYCLEPTUS*.
- AA. Dorsal fin short, 10 to 18 developed rays.
 - D. Air bladder in 2 parts.
 - E. Lateral line present, complete and continuous; scales small, more than 50 in lateral line.— *CATOSTOMUS*.
 - EE. Lateral line interrupted or wanting, scales large, less than 50 in lat. line.
 - F. Lateral line entirely wanting.— *ERIMYZON*.
 - FF. Lateral line more or less developed, especially in the adult.— *MINYTREMA*.
 - DD. Air bladder in 3 parts; scales large; lateral line complete.
 - G. Mouth normal, the lower lip entire or merely lobed, the upper lip protractile.
 - H. Pharyngeal bones moderate, the teeth compressed, not molar-like, increasing in size gradually downward.— *MOXOSTOMA*.
 - HH. Pharyngeal bones very strong, the lower teeth very much enlarged, cylindrical and truncate, molar-like.— *PLACOPHARYNX*.
 - GG. Mouth singular, the upper lip not protractile, greatly enlarged, the lower lip developed as two separate lobes.— *LAGOSCHILA*.

Genus: *ICTIOBUS*.

Key to Species.

- A. Mouth large, terminal, protractile forward; lips very thin, lower pharyngeals and teeth weak.— *cyprinella*.
- AA. Mouth smaller, more or less inferior, and with thicker lips; pharyngeal bones stronger; the teeth comparatively coarse and large.
 - B. Back scarcely elevated, depth 3 to $3\frac{1}{4}$ in length.— *urus*.
 - BB. Back elevated and compressed, depth $2\frac{1}{2}$ to $2\frac{3}{4}$.— *bubalus*.

Ictiobus cyprinella (Cuvier and Valenciennes). COMMON BUFFALO FISH;
RED-MOUTHED BUFFALO.

Head very large and thick, $3\frac{1}{2}$ in length; depth $2\frac{1}{2}$ to $3\frac{1}{2}$. Developed rays of dorsal fin 27 to 29; anal 9; ventrals 10. Scales 7-37 to 41-6. Body robust, moderately compressed, the outline somewhat elliptical, but the back rather more curved than the belly. Opercular apparatus very strong, the operculum forming nearly $\frac{1}{2}$ the length of the head. Color dull brownish olive, not silvery, fins dusky. Length nearly 3 feet.

According to Jordan, the Red-mouthed Buffalo Fish abounds in the Ohio river and its larger tributaries, and Henshall reports it "very common in Ohio river." Not reported for any other locality:

Ictiobus urus (Agassiz). MONGREL BUFFALO; RAZOR-BACKED BUFFALO.

Head very stout, strongly transversely convex, thicker, larger and less pointed than in *I. bubalus*, about 4 in length. Eye about equal to snout, $5\frac{1}{2}$ in head, much smaller than in *I. bubalus*. Mouth large, considerably oblique, approaching that of *I. cyprinella*. Body much less elevated and compressed than in *I. bubalus*, the back not at all carinated; 3 to $3\frac{1}{4}$ in length. D. 30; A. 10; scales 8-41-7. Longest ray of dorsal scarcely $\frac{1}{2}$ the length of base of fin; anal rounded. Colors very dark, fins all black. "Not always separable from *I. cyprinella*, and perhaps not really different."

Ohio river at Cincinnati, Henshall, 1889. Not mentioned by any other collector.

Ictiobus bubalus (Rafinesque). BUFFALO FISH; SMALL-MOUTHED BUFFALO; RAZOR-BACK; SUCKER-MOUTHED BUFFALO.

Head moderate, triangular in outline when viewed from the side, 4 in length, mouth quite small. Body considerably elevated and compressed above; the dorsal region sub-carinate, the belly thicker; depth $2\frac{1}{4}$ to $2\frac{3}{4}$. Highest dorsal ray reaching much beyond middle of fin; D. 29; A. 10; V. 10; scales 8-39-6. Color brownish olive, paler below, the lower fins slightly dusky. Length 30 inches.

Recorded by Rafinesque for the Ohio, "as far as Pittsburg." Also recorded for the state by Kirtland. "Abundant in the Ohio river," Henshall, 1888. Not recorded for any other point of the state.

Genus: CARPIODES.

Key to Species.

- A. Body sub-fusiform, depth about 3 in length. Dorsal with about 30 rays.— *carpio*.
- AA. Body ovate oblong, the back elevated, depth about $2\frac{1}{2}$ in length.
 - B. Lips thin, silvery white, the halves meeting in a wide angle.
 - C. Head large, snout blunt; eye large, $3\frac{1}{2}$ to 4.— *difformis*.
 - CC. Head small and pointed, the snout projecting, eye small, 5 to $5\frac{1}{2}$ in head.— *thompsoni*.
 - BB. Lips full, thick, reddish in life, the halves of lower lip meeting in an acute angle.— *velifer*.

Carpiodes carpio (Rafinesque). BIG CARP SUCKER.

Head comparatively short, 4 to 5 in body. Body more fusiform than in others of the genus, compressed, but not much arched, depth $2\frac{2}{3}$ to 3.

Anterior rays of dorsal short, much thickened and osseous at base, especially in adults, the longest ray a little more than $\frac{1}{2}$ the base of the fin, which consists of 30 rays; caudal moderately forked. Eye medium, anterior, $4\frac{1}{2}$ in head. Muzzle short, but projecting beyond mouth. 36 scales in lateral line.

Limited in its distribution to the Ohio and its larger tributaries. "The commonest species of its genus in the Ohio river, and it is often found in the streams of the interior," Jordan. Very abundant in the Ohio river, Henshall, 1888; Ohio river at Bellaire, R. C. Osburn, 1900.

***Carpiodes difformis* Cope.**

Snout very blunt, the maxillary reaching to front of pupil. Nostrils very near tip of snout. Lips thin, silvery colored in life, the lower Ω -shaped. Head $4\frac{1}{4}$ in body; depth $2\frac{1}{4}$ to $2\frac{3}{4}$, the back considerably elevated. Eye quite large, $3\frac{1}{2}$ to 4 in head. D. 24, its first rays very high; A. 8; V. 9; scales, 6-35-4.

Recorded for the state by Jordan, under the name of *C. cutisanserinus* (Cope), as "abundant in the Ohio." *C. cutisanserinus* is now regarded as identical with *C. difformis*. "Abundant in Ohio river, young common in Little Miami river," Henshall, 1888. Klippart, in his first report, says of this species, that it "abounds in Lake Erie, but this must be a mistake, probably in regard to the species, as *C. difformis* is not, I believe, known to occur in the St. Lawrence System."

***Carpiodes thompsoni* Agassiz. LAKE CARP.**

Body stout, short, the back much elevated, depth $2\frac{1}{2}$ in length. Head small, 4 to $4\frac{1}{2}$ in length, the snout pointed; lips thin, white, meeting at a wide angle. Eye small, 5 to $5\frac{1}{2}$ in head. Tip of lower jaw much in advance of nostrils; maxillary reaching line of orbit. Dorsal of about 27 rays, arising about midway from snout to base of caudal, its anterior rays high, $2\frac{2}{3}$ as long as base of fin. A. 7; V. 10; scales rather closely imbricated, 8-39 to 40-6.

"Abundant in Lake Erie. I have examined many specimens from Sandusky Bay," Jordan; Lake Erie, Henshall, 1889; Lorain County, "not very common," McCormick, 1892; Lake Erie at Toledo, Jordan and Evermann (Bull. 47, U. S. Nat'l. Mus.).

Carpiodes velifer (Rafinesque). QUILL BACK ; SPEARFISH.

Head $3\frac{3}{4}$ to 4; lips thick, full, flesh-colored in life, the halves of the lower meeting at an acute angle; muzzle projecting, conic; eye 4 to 5 in head. Back much arched; depth $2\frac{1}{2}$ to 3. Dorsal fin of about 27 rays, the anterior rays very long and filamentous, sometimes as long as the base of the fin. Caudal deeply forked, its lobes slender, the upper lobe the longer. Scales 7-35-5.

Recorded by Rafinesque for the Ohio river as far as Pittsburg. "Quite common in Ohio river, young ones common in Little Miami river and tributaries," Henshall, 1888; Maumee river at Antwerp, Defiance, Grand Rapids and Toledo, Tiffin river at Brunersburg, Auglaize river at Cloverdale, Oakwood and Defiance, Blanchard river at Ottawa and Cloverdale, Hoaglin creek near Oakland, Beaver creek at Grand Rapids, "rather common at all these points," Kirsch, 1893; Scioto river, Scioto Big Run, Mason's Run and Hell Branch, Williamson and Osburn, 1897; Scioto river at Ironton, Wabash river at Celina, Wolf creek near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Breakneck creek and Cuyahoga river near Kent, Chippewa lake, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, R. C. Osburn, 1900.

Cycleptus elongatus (Le Sueur). BLACK HORSE ;
MISSOURI SUCKER.

Depth 4 to 5; head 6 to $8\frac{1}{2}$; eye small, 6 to 7 in head. D. 30, its longest ray a little longer than head; A. 7 or 8; scales 9-56-7. Color very dark, males in spring almost black. Length $2\frac{1}{2}$ feet.

Apparently confined in this state to the Ohio river. "As far as Pittsburg," Rafinesque. Recorded for the Ohio by Kirtland and by Jordan, and Henshall in 1888 mentions it as "not uncommon in the Ohio river.

Genus: CATOSTOMUS.*Key to Species.*

- A. Head transversely convex above, the orbital rim not elevated, scales in lateral line 60 or more.
- B. Scales in lateral line about 100.— *catostomus.*
- BB. Scales in lateral line 64 to 70.— *commersonii.*
- AA. Head broad, depressed, and transversely convex between the orbits; scales in lateral line, 48 to 55. *nigricans.*

Catostomus catostomus (Forster). NORTHERN SUCKER.

This species can at once be distinguished from the others of the genus occurring in Ohio, by the great number of scales in the lateral line, 95 to 114. About 29 cross rows between dorsal and ventrals. Head broad above, pointed in front; snout a little longer than remainder of head and much overhanging the mouth. Body rather slender and somewhat terete. D. 10; A. 7. Color, above, smoky gray; below, white. Length $2\frac{1}{2}$ feet.

This species is one of northern distribution, probably not occurring in the tributaries of the Ohio. "Quite abundant in Lake Erie," Jordan (Ohio Rept.), 1878; Lake Erie, Henshall, 1889.

Catostomus commersonii (Lacepede). COMMON SUCKER;
FINE-SCALED SUCKER.

Head rather conical, $4\frac{1}{4}$ in length of body, flattish above, but not concave between the eyes. Body moderately stout, terete or sub-terete, becoming heavier at the shoulders with age, depth 4 to 5 in length. D. 11 or 12; scales small, 10-64 to 70-9. Color olivaceous, tending toward blackish on back and lateral line. Length 18 inches.

One of the commonest species in the state, found in abundance in nearly every stream. Recorded for the state by Kirtland for the Big Miami, and small brooks of northern Ohio; "Swarming in every pond and stream in Ohio," Jordan (Ohio Rept.); Hamilton County, "Everywhere abundant," Henshall, 1888; Lorain County, "Very common in all our waters," McCormick, 1892; recorded by Kirsch for nearly every locality seined in the Maumee River System, 1893; taken by Mr. Williamson and myself in every stream in Franklin County, 1897; in every stream of the Big Jelloway Creek System in Knox County, Parker, Williamson and Osburn, 1898; taken by myself in 1899, at the following places: Ohio river and Ice creek at

Iron-ton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, and North Fork of Licking river at Newark; and in 1900 in the Cuyahoga river at Hawkins, Break-neck creek near Kent, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river, and McMahon's Run at Bellaire, and Licking reservoir.

Catostomus nigricans Le Sueur. HOG SUCKER; STONE ROLLER.

Head large, concave between the eyes, $\frac{1}{4}$ in length. Body nearly terete, depth $4\frac{1}{2}$ to 5. D. 10 or 11; scales 48 to 55 in lateral line. Color, olive, becoming brownish on the back, which is crossed by several dark, irregular blotches; belly white. Length 2 feet.

This Sucker is very widely distributed over the state, being found in all suitable localities. Its especial haunts are clear, stony ripples and rock-bottomed pools. Not taken in lakes. Kirtland records it as two species, *Hypentelium macropteron* and *Catostomus nigrans*; "extremely abundant in every running stream in Ohio," Jordan (Ohio Rept.); Hamilton County, "everywhere abundant," Henshall, 1888; Lorain County, McCormick, 1892; Kirsch, 1893, records it for the streams at nearly all points investigated in the Maumee River System, "none taken in the lakes"; Franklin County, Scioto river, Olentangy river, Scioto Big Run, Grant's Run, Big Walnut creek, Rocky Fork, Black Lick, Alum creek, Big and Little Darby creeks and Hell Branch, Williamson and Osburn, 1897; every stream in the Big Jelloway Creek System, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Iron-ton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton and North Fork of Licking river at Newark, R. C. Osburn, 1899; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's creek at Bellaire, and the outlet of Licking reservoir into Licking river, R. C. Osburn, 1900.

Genus: ERIMYZON.

Erimyzon sucetta oblongus (Mitchell). SWEET SUCKER;
CHUB SUCKER.

Head 4 to $4\frac{1}{4}$ in length; snout not projecting; eye $4\frac{1}{4}$ to $4\frac{3}{4}$ in head. Body stout, compressed; depth in adults about 3, but younger specimens much more slender; back arched, old specimens becoming quite gibbous at the nape. Lateral line entirely wanting. Scales about 40, closely imbricated and somewhat crowded anteriorly, sometimes showing irregularities of arrangement. Length 10 inches. Color varying with age, in adults brown or brownish olive above, with a tendency to brassy on sides and belly; younger specimens are plain olivaceous, occasionally bright, "gold-fish yellow"; very young with a distinct, black lateral band, which breaks up into blotches a little later. Ohio specimens show some variations between the typical *E. sucetta* and the variety *oblongus*, but seem to agree more closely with the variety than with the typical form.

The Chub Sucker, or Sweet Sucker, is widely distributed over the state, but its occurrence is irregular. At some points it is an abundant species, at others rare. "Common in Little Miami and Ohio rivers," Henshall, 1888; "not common, I have taken a few in the lower part of Beaver creek," McCormick, 1892; Maumee river at Toledo, St. Joseph river at Edgerton, St. Mary's river at St. Mary's, Tiffin river at West Unity, Lost and Gordon creeks near Cecil, Kirsch, 1893; Franklin County, Scioto river, Scioto Big Run, Grant's Run, Big Darby, Little Darby and Hell Branch, Osburn and Williamson, 1897; Ohio river at Ironton, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, R. C. Osburn, 1899; Licking reservoir, E. B. Williamson; Sandusky Bay, very common in Black Channel, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, and Ohio river and McMahon creek at Bellaire, R. C. Osburn, 1900.

Genus: MINYTREMA.

Minytrema melanops (Rafinesque). WINTER SUCKER; SPOTTED SUCKER;
STRIPED SUCKER.

Head $4\frac{1}{4}$; snout round, a trifle projecting. Body elongate, somewhat terete, back somewhat arched in front of dorsal fin; depth about 4. D. 12; A. 7. Scales about 46. Lateral line wanting in young, present but more or less interrupted in adults. Coloration dusky olive above, each scale with a more or less distinct black spot at its base, these forming rows along the rows of scales. Length about 18 inches.

Not usually a common species, though widely distributed. Recorded by Kirtland, 1838; Hamilton County, Little Miami and tributaries, Henshall, 1888; Lorain County, "Rare, Vermillion river and Beaver creek," McCormick, 1892; Maumee river at Grand Rapids, St. Joseph river at Edgerton, Fish creek at Edgerton, St. Mary's river at St. Mary's and Rockford, Auglaize river at Wapakoneta and Cloverdale, Blanchard river at Findlay, Kirsch, 1893; Franklin County, Scioto river, Olentangy river, Black Lick, Little Walnut and Big Darby, Williamson and Osburn, 1897; Stillwater creek near Dayton, and Wabash river near Celina, R. C. Osburn, 1899. At the latter place, in a series of pools formed by the outlet of St. Mary's reservoir, the species was taken in abundance, the only time I have ever taken more than a few individuals in one locality.

Genus: MOXOSTOMA.

Key to Species.

- A. Dorsal fin of 15 to 18 rays; lower lip V-shaped.— *anisurum.*
- AA. Dorsal fin of less than 15 rays; lower lip truncate behind, not evidently V-shaped.
- B. Head rather large, 4 to nearly 5 in length, snout little projecting.—*aureolum.*
- BB. Head small and conic, about $5\frac{1}{4}$ in length, the snout much projecting beyond the small mouth.— *breviceps.*

Moxostoma anisurum (Rafinesque). WHITE-NOSED SUCKER.

Head short and broad, flattened above, $3\frac{2}{3}$ to $4\frac{1}{4}$ in length, eye midway in head, 4 to 5 in its length. Body compressed; back high, considerably more arched than in *M. aureolum*; depth $3\frac{1}{2}$ in length. Fins all large. Color bright olivaceous to smoky above, white or silvery on sides and belly. Most easily distinguished from other species of the genus occurring in Ohio, by the long dorsal fin, containing from 15 to 18 rays.

This species is found in both the Lake and Ohio river drainage, but is not usually very common, and is confined to the larger streams. Ohio river, "as far as Pittsburg," Rafinesque. Given by Jordan (Ohio Rept.) as three species—*M. anisurum*, of which he says, "I have seen a few specimens, obtained in the Cincinnati market"; *M. velatum*, "frequently taken in the Ohio river and its tributaries," and *M. carpio*, from Lake Erie and the Ohio at Cincinnati and Marietta. These three are now regarded as synonymous (See Bull. 47, U. S. Natl. Mus.). Hamilton County,

not uncommon in Ohio river, Henshall, 1888; Lorain County, McCormick, 1892; Maumee river at Antwerp, Defiance and Toledo; Tiffin river at West Unity and Brunersburg, Auglaize river at Cloverdale, Oakwood and Defiance; Blanchard river at Ottawa, Hoaglin creek near Oakwood, Beaver creek at Grand Rapids, Kirsch, 1893; Franklin County, Scioto river, Olentangy river and Alum creek, Williamson and Osburn, 1897; Ohio river at Ironton, Huron river at Milan, R. C. Osburn, 1899; Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

***Moxostoma aureolum* (Le Sueur). RED-HORSE; MULLET;
WHITE SUCKER.**

Head 4 to 5, flattened above; snout slightly projecting; eye $4\frac{3}{4}$ in head. Body rather stout, somewhat compressed; back, little elevated; depth 4 in length. D. 13, or more rarely 12 or 14; A. 7; scales about 45. Color olivaceous above, sides silvery; lower fins reddish, especially during the breeding season.

Until very recent years this has been recorded as two species, the short-headed, small-mouthed form as *M. aureolum*, and the more ordinary form as *M. macrolepidotum duquesnii* (Le Sueur). This matter is cleared up by Jordan and Evermann (Bull. 47, U. S. Natl. Mus.). It is very probable that some collectors have confused the short-headed form with *M. breviceps* (Cope), as I can find no record of *M. breviceps* for Ohio in any paper preceding Bull. 47, U. S. Natl. Mus., in which it is recorded as abundant in some portions of the state. However, as I have no direct evidence of any such error, I include all records for *M. aureolum* and *M. macrolepidotum duquesnii* under *M. aureolum*. Ohio river, "as far as Pittsburg," Rafinesque; recorded for the state by Kirtland as *Catostomus aureolus*, *C. Duquesnii* and *C. erythrus*; Hamilton County, "abundant in all streams explored," Lake Erie, Henshall, 1888-89; Lorain County, McCormick, 1892; Maumee river at Defiance, Grand Rapids and Waterville, St. Mary's river at Rockford, Auglaize river at Oakwood, Sugar creek at Lima, St. Joseph river at Edgerton, west end of Lake Erie, Kirsch, 1893; Franklin County, "abundant, taken in all but the smallest streams," Williamson and Osburn, 1897; Knox County, Big Jelloway creek system, "abundant, the young fry

ascending even the smallest brooks," May 26 given as a breeding date, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Wheeling, Licking reservoir, R. C. Osburn, 1900.

***Moxostoma breviceps* (Cope).**

Form of a *Coregonus*, with deep, compressed body, small head, and a conic snout, which overhangs the very small mouth. Caudal fin, with the upper lobe falcate, much longer than the lower. Dorsal fin short, high, falcate, the anterior rays $1\frac{1}{3}$ to $1\frac{1}{2}$ times base of fin, the free border much concave. Depth $3\frac{1}{2}$ in length. Head 5 to $5\frac{1}{4}$. D. 12 or 13. Scales 6-45-5. Lower fins bright red.

"Abundant in Lake Erie; our specimens from Sandusky, Toledo and Cincinnati," Jordan and Evermann (Bull. 47, U. S. Natl. Mus.).

Genus: PLACOPHARYNX.

***Placopharynx duquesnii* (Le Sueur).**

Head 4; snout rounded, projecting; lower jaw somewhat oblique when closed; eye $4\frac{1}{2}$ in head. Body rather stout, somewhat compressed, in form like that of *M. aureolum*; D. 13; A. 7 (not 9, as is usually given, in any Ohio specimens I have seen); scales 6-45-6. Lower pharyngeal bones very strong, the lower teeth on these bones very strong and molar-like, little compressed, and having broad grinding surfaces.

This species so closely resembles *M. aureolum* that it can be positively distinguished only by the appearance of the lower pharyngeal teeth, and it has no doubt been much overlooked. Recorded by Jordan (Ohio Rept.) on the strength of a skeleton found by Dr. J. M. Wheaton in the Scioto river at Columbus, one of the very few specimens known at that time. The species has since proved to be well distributed over the state, though not usually abundant. Hamilton County, not rare in the Ohio, Henshall, 1888; Lorain County, Lake Erie, common with other

mullets, McCormick, 1892 ; Franklin County, Scioto river, Olen-tangy river and Big Darby creek, Williamson and Osburn, 1897 ; Ohio river at Ironton, Wabash river at Celina, R. C. Osburn, 1899 ; Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: LAGOCHILA.

Lagochila lacera Jordan and Brayton. HARE-LIP SUCKER ;
CUT-LIPS.

Head short, conical, with lengthened snout, the region between the eyes flattened and with prominent mucous ridges. Cheeks and lower part of head rather swollen. Opercle much reduced, its greatest length scarcely greater than diameter of eye. Head $4\frac{2}{3}$ in length. Eye $4\frac{1}{2}$ in head, 2 in length of snout. Body rather slender, depth $4\frac{2}{3}$. Dorsal fin rather low, its rays 12 ; A. 7 ; V. 9 ; scales 5-45-5. Mouth very singular ; the upper lip is broad and fleshy, not separated from the skin of the forehead by a crease ; at each side of the mouth a sharp fold of skin is formed, which descends to the mid line below, passing under the lower jaw, but is separated from that of the opposite side by a longitudinal crease ; in front of these the fleshy lower lip is split into two large depending lobes.

This species has been recorded for but three localities in the state. Its rare occurrence in the state was first noted by Dr. Jordan in Klippart's "Second Annual Report of the Ohio State Fish Commission for 1877," where he says : "Mr. Klippart finds it very abundant in the Scioto, where it has been overlooked by all the collectors from Rafinesque and Kirtland down," and Mr. Klippart further comments : "The fisherman assured me that he had taken them several years in succession." Twenty years later, the investigations on the fishes of Franklin County, carried on by Mr. Williamson and the writer, and extending over a period of several years, failed to bring to light a single specimen of this species, though the Scioto river was hauled in many places. The species has been taken in the state by Kirsch, in 1893, in the Auglaize river at Cloverdale, and in the Blanchard river at Ottawa.

*Family: CYPRINIDÆ (The Minnows).**Key to Genera.*

- I. (Dorsal fin long, with 2 or 3 spines, and 18 or 20 rays; introduced species.)
- A. Teeth in 3 rows, 1, 1, 3-3. 1, 1, all molar; 4 barbels.— CYPRINUS.
- AA. Teeth in 1 row, 4-4, molar, but compressed; barbels wanting.— CARASSIUS.)
- II. Dorsal fin short, without developed spine.
- A. Air bladder surrounded by many convolutions of the very long alimentary canal.— CAMPOSTOMA.
- AA. Air bladder above the alimentary canal, not surrounded by convolutions of the intestine.
- B. Alimentary canal more than twice the length of body; teeth in 1 row; peritoneum usually black.
- C. Teeth 5-5 or 4-5; scales minute.— CHROSOMUS.
- CC. Teeth 4-4; scales larger.
- D. A small barbel present at base of maxillary; color silvery.— HYBOGNATHUS.
- DD. Barbel wanting; color olivaceous, little silvery.— PIMEPHALES.
- BB. Alimentary canal less than twice the length of body; peritoneum usually silvery.
- E. Lower jaw normally formed, dentary bones free from each other except at the symphysis.
- F. Teeth in main row 5-5 or 4-5.
- G. Abdomen rounded behind ventral fins, not compressed into a scaleless ridge; anal basis short.
- H. A minute barbel present on maxillary at a little distance above its base.— SEMOTILUS.
- HH. Maxillary without barbel.
- I. Teeth in 2 rows, 2, 4-5, 2.— LEUCISCUS.
- II. Teeth in 1 row, 5-5. Mouth extremely small.— OPSOPEODUS.
- GG. Abdomen compressed behind ventral fins into a sharp, scaleless ridge; anal basis longer.— ABRAMIS.
- FF. Teeth in main row 4-4.
- J. Maxillary without barbel.
- K. No cavernous lymph spaces visible in mandible, sub-opercle and inter-opercle.
- L. First (rudimentary) ray of dorsal detached from the first developed ray and connected to it by a membrane; a conspicuous black spot at base of caudal and dorsal.— CLIOLA.
- LL. First (rudimentary) ray closely attached to first developed ray.— NOTROPIS.
- KK. Mandible, sub-opercle and inter-opercle, with conspicuous, externally visible, cavernous lymph chambers.— ERICYMBA.
- JJ. Maxillary barbel present.
- M. Premaxillaries not protractile, connected to skin of forehead in the median line without a cross groove; teeth 2, 4-4, 2. RHINICHTHYS.
- MM. Premaxillaries protractile, a cross groove separating them from the skin of forehead in front; only 1 tooth in lesser row.— HYBOPIS.
- EE. Lower jaw singularly formed, the dentary bones parallel and united for their entire length; a conspicuous, fleshy lobe on each side at base.— EXOGLOSSUM.

*Genus: CYPRINUS.***Cyprinus carpio** Linnaeus. THE CARP.

The Carp may be readily distinguished from any of our native *Cyprinidæ* by the presence of four long barbels, and by the very long dorsal fin—about 20 rays—preceded by a stout spine, which is serrated behind. Anal fin short, of about 5 rays, also preceded by a spine. The lower pharyngeal teeth, unlike those of any native American Minnow, are in 3 rows, 1, 1, 3-3, 1, 1. The lateral line is complete. Many varieties have resulted from cultivation. Chief among these are the "Full-scale," in which the body is covered with strong scales, after the formula, 6-40-5; the "Half-scale" or "Mirror," characterized by a few rows of very large scales; and the "Leather Carp," in which the scales are entirely absent.

The Carp was first introduced into the state to stock ponds and lakes, but, escaping from cultivation, has become generally distributed over the state and occurs in streams as well as ponds and lakes. Recorded for the state by Henshall, 1889, in Ross lake and Little Miami river; Lorain County, occasionally taken in the rivers, McCormick, 1892; Maumee river at Toledo (abundant), St. Marys river at Rockford, Tiffin river at West Unity, and west end of Lake Erie (abundant), Kirsch, 1893; Franklin County, "of general distribution throughout the county," Williamson and Osburn, 1897; Knox County, Big Jelloway creek, "very common," Parker, Williamson and Osburn, 1898; very common in Sandusky Bay, R. C. Osburn, 1899; Wheeling creek at Bridgeport, Ohio river at Bellaire, and Licking reservoir, R. C. Osburn, 1900.

*Genus: CARASSIUS.***Carassius auratus** (Linnaeus). GOLDFISH.

The Goldfish may be distinguished from our native Minnows by the very long dorsal fin, preceded by a stout, serrated spine; the anal of 7 rays, with a similar spine. From the Carp it is distinguished by the absence of the barbels about the mouth, and by the teeth, which are 4-4. As in the Carp, cultivation has produced many varieties.

It has escaped from cultivation in some parts of Ohio, and has been reported by Henshall, 1888, as "not rare in the canal basin near Elmwood, Hamilton County.

*Genus: TINCA.***Tinca tinca** (Linnaeus). TENCH.

In the spring of 1898 a freshet carried away the banks of an artificial lake on the grounds of the Ohio State University, at Columbus, and many of the Tench, with which the lake was stocked, escaped into the Olentangy river. In September of the same year specimens were taken at the mouth of the small stream flowing from the lake to the river. Whether the Tench will hold its own in the streams of Ohio yet remains to be seen.

Genus: CAMPOSTOMA.

Campostoma anomalum (Rafinesque). STONE-ROLLER;
STEEL-BACKED CHUB; MAMMY; DOUGH-BELLY.

This species is most easily distinguished by an examination of the intestine, which is very long and is wound in many convolutions about the air-bladder. This arrangement is peculiar to this genus among all known fishes. Head 4; depth $4\frac{2}{3}$; eye 5 to $5\frac{1}{2}$ in head; D. 8; A. 7; scales 7-48-6; teeth 4-4. Body stoutish. Snout somewhat decurved, mouth inferior. Color brownish, almost black in adult breeding males; sides brassy, irregularly mottled with dark olivaceous or brown; fins usually plain, in breeding males the dorsal is tinged with orange, a black bar through its middle, other fins more or less tinged with orange. Entire dorsum of breeding males covered with tubercles. Young with a dark lateral band extending onto gill covers and between eye and tip of snout. Length 6 to 8 inches.

A very abundant and widely distributed species, generally most abundant in small streams and on ripples of larger ones. First recorded for the state by Kirtland under the name *Exoglossum lesueurianum*; given by Jordan as "extremely abundant in every stream in the state"; Hamilton County, "abundant in every stream explored," Henshall, 1888; Lorain County, "common in most of our streams," McCormick, 1892; Franklin County, "very abundant everywhere," Williamson and Osburn, 1897; Big Jelloway creek system, "apparently the most abundant species," Parker, Williamson and Osburn, 1898; recorded for many places in the Maumee river system (not taken in St. Mary's river) by Kirsch, 1893; Ohio river and Ice creek at Iron-ton, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, north fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Chippewa lake, Summit lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: CHROSOMUS.**Chrosomus erythrogaster** Rafinesque. RED-BELLIED DACE.

Head 4; depth 4; eye $3\frac{1}{2}$. D. 8; A. 8; teeth 5-5; scales 16-85-10. Body rather elongate, the head pointed; mouth small, terminal, somewhat oblique. Lateral line developed backward about as far as the dorsal fin. Color above, brownish; a black vertebral line, bordered on either side by a row of black dots; sides creamy white, bordered above and below with a black band, the lower the wider and extending forward through eye; under parts white, in breeding males entirely suffused with vermillion; fins all bright sulphur yellow, the dorsal with a bright red spot at its base, anteriorly; females and young less brilliantly colored. Length 2 to 3 inches.

The Red-bellied Dace is widely distributed and is generally abundant where found, but it is strictly a "brook species," being confined to small clear streams and spring runs. Recorded for the state by Dr. Kirtland: Lorain County, "I have found them in but one stream, Spring brook," McCormick, 1892; "collected by Prof. Meek in Lost creek, near Defiance," Kirsch, 1893; Franklin County, Grant's Run and Plum Run, tributaries of the Scioto river, in abundance, Williamson and Osburn, 1897; Knox County, Parker's Run, a tributary of Big Jelloway creek, "in considerable numbers," Parker, Williamson and Osburn, 1898; Licking County, occurring in abundance in spring runs tributary to North Fork of Licking river near Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900.

Genus: HYBOGNATHUS.**Hybognathus nuchalis** Agassiz. SILVERY MINNOW.

Head $4\frac{1}{2}$ to 5; depth $4\frac{1}{8}$; eye 4; D. 8; A. 7; teeth 4-4; scales 5-38-4. Body elongate, comparatively slender. Head moderate, the profile evenly curved; upper jaw heavy, lower thin. Scales large and silvery, 12 to 14 in front of dorsal. Lateral line decurved. Intestines very long, 7 to 10 times the length of body. Color olivaceous green above, translucent in life; sides clear silvery; fins plain. Length 4 to 7 inches.

This species seems to be confined to the southwestern part of the state. Jordan, in his Ohio Report, gives it as abundant in small streams flowing into the Ohio river, but Dr. Henshall records it for only White Oak creek and the Ohio river, and in my work at Ironton and Bellaire I failed to find it. This species is not mentioned by any other collector.

Genus: PIMEPHALES.*Key to Species.*

- A. Lateral line more or less incomplete; body very short and stout.— *promelas.*
 AA. Lateral line complete; body moderately elongate.— *notatus.*

Pimephales promelas Rafinesque. FAT-HEAD.

Head 4; depth $3\frac{3}{4}$ to 4; eye 4. D. I, 7; A. 7; scales 7 or 8-43 to 47-5 or 6. Body very short and deep. Head short, everywhere convex, almost globular in adult males. Scales deep, closely imbricated; lateral line incomplete. Color dark olivaceous above, paler below; a dark lateral band and caudal spot; dorsal fin with a dusky shade through it at the middle. Breeding males with the head nearly black, with tubercles on snout and lower jaw. Length $2\frac{1}{2}$ inches.

Recorded by Kirtland. Given by Jordan as most abundant in small streams flowing into the Ohio; Hamilton County, "very abundant everywhere," Henshall, 1888; Lorain County, "not common, but found in most of the streams," McCormick, 1892; Maumee river at Cecil, Lost and Gordon creeks near Cecil, Sugar creek at Lima, Kirsch, 1893; Knox County, Big Jelloway creek, rare, Parker, Williamson and Osburn, 1898; Ohio river at Iron-ton, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Pippin lake, Cuyahoga river at Hawkins. Ohio river at Bellaire, R. C. Osburn, 1900.

Pimephales notatus (Rafinesque). BLUNT-NOSED MINNOW.

Head $4\frac{1}{2}$; depth $4\frac{1}{2}$ to 5; eye 4. D. I, 7 or 8; A. 7; scales 6-45-4, 22 in front of dorsal, much crowded and irregularly arranged anteriorly. Body rather elongate. Head moderate, the snout very blunt and convex; top of head depressed; mouth small, inferior, horizontal. Color olivaceous, sometimes very dark; a black spot at base of dorsal fin in front. Males in breeding season with the head black or nearly so, and with about 16 large tubercles on the snout. Length 4 inches.

This species is much more abundant than the preceding. "Swarms in all the streams of the state," Jordan; Hamilton County, "the most abundant minnow," Henshall. 1888; Lorain County, "very abundant in small streams," McCormick, 1892; Kirsch records it for every stream of the Maumee river system explored in Ohio; Franklin County, "our most abundant minnow,"

in great numbers in every stream," Williamson and Osburn, 1897 : Knox County, abundant in every stream of the Big Jelloway creek system, Parker, Williamson and Osburn, 1898 ; Ohio river and Ice creek at Ironton, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river near Newark, R. C. Osburn, 1899 ; Niggermill Run at Salem, Mahoning river, E. B. Williamson, 1900 ; Pippin lake, Chippewa lake, Summit lake, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: SEMOTILUS.

Semotilus atromaculatus (Mitchill). HORNED DACE ; CHUB.

Head $3\frac{3}{4}$; depth 4 ; eye 5 to $5\frac{1}{2}$. D. 7 ; A. 8 ; scales 9-55 to 60-6, about 30 in front of dorsal ; teeth 2, 5-4, 2. Head large and heavy, broad and rounded above ; snout broad ; mouth broad, oblique ; a small barbel on the maxillary some distance above its posterior end, not evident in young specimens. Body stout, arched in front of dorsal. Dorsal inserted behind ventrals. Color dusky olivaceous or bluish above, paler below ; sides with a brassy luster ; an indistinct lateral band and caudal spot (these markings distinct in young). Dorsal with a black spot at its base anteriorly. Sides of head and lower fins rosy in breeding males. These have also the snout covered with tubercles. Length 10 inches.

A widely distributed species, occurring abundantly in brooks throughout the state, less commonly in the larger streams, and rarely in lakes. In seining up stream the increase in number of individuals of this species as the headwaters are approached is very noticeable. Kirtland, following Rafinesque, recorded it for the state as two species, *S. dorsalis* and *S. cephalus*. Both are synonyms of *S. atromaculatus*. Hamilton County, "abundant in all streams," Henshall, 1888 ; Lorain County, "abundant in most of the streams," McCormick, 1892 ; "generally distributed throughout the Maumee river basin," Kirsch, 1893 ; Franklin County, abundant in all streams, Williamson and Osburn, 1897 ; Knox County, Big Jelloway creek system, Parker, Williamson

and Osburn, 1898; Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, Mahoning river, E. B. Williamson, 1900; Sandusky Bay, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, R. C. Osburn, 1900.

Genus: LEUCISCUS.

Leuciscus elongatus (Kirtland). RED-SIDED DACE.

Head 4; depth 5; eye 4 to $4\frac{1}{3}$. D. 8; A. 9; scales 10-70-5; teeth 2, 5-4, 2. Body elongate, compressed; head long, pointed; mouth very large, oblique, the maxillary extending to middle of orbit; lower jaw projecting, with a small knob at its symphysis. Color above varying from a dark bluish to greenish, sides somewhat paler and mottled; a dark vertebral line; along the side is a broad band, bright blood red anteriorly, black posteriorly, the two colors shading into each other imperceptibly at about middle of body; above this band is a narrow brassy band; belly silvery white. In breeding males the belly and lower fins are tinged with rosy; in females and young the bright colors are subdued or wanting. Length 5 inches.

The Red-sided Shiner is certainly one of the most elegant of fishes. It is, generally speaking, a brook species, inhabiting clear deep pools of brooks and spring runs, though Dr. Kirtland, who described the species, records it for Lake Erie. It is found in the tributaries of the Ohio and of the Lake, but has not been noticed in the western part of the state. Mahoning river in Trumbull County, and Lake Erie near Cleveland, Kirtland; Lorain County, "common in Spring brook, but not found elsewhere," McCormick, 1892; Knox County, Little Jelloway creek, Black Run, Parker's Run, Joe Sapp Run, Shadly Run and Doudy creek, tributaries of Big Jelloway creek, common, Parker, Williamson and Osburn, 1898; Wilson's Run, a small tributary of the North Fork of Licking river near Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; a small tributary of the Grand river at Painesville, R. C. Osburn, 1900.

*Genus: OPSOPŒODUS.**Key to Species.*

- A. Lateral line complete or very nearly so; dorsal fin with black blotch on anterior rays, usually none on the posterior.— *emiliæ*.
 AA. Lateral line always incomplete; dorsal usually with a conspicuous black spot on posterior rays.— *megalops*.

Opsopœodus emiliæ Hay.

Head about $4\frac{1}{2}$; depth $4\frac{2}{5}$; eye 3. D. 9; A. 8; scales 5-40-3; teeth 5-5, very slender, strongly hooked, and deeply serrate. Body rather elongate, moderately compressed, not elevated. Head short and slender. Muzzle blunt and rounded. Mouth very small and very oblique, smaller than in any other of our *Cyprinidae*, with scarcely any lateral cleft. Caudal peduncle long and slender, caudal deeply forked. Breast naked; 16 scales before dorsal. Lateral line complete or very nearly so. Yellowish; sides silvery; scales above dark edged; usually a dark lateral band from snout to caudal, above and below which are series of black dots; anterior rays of dorsal dark, no black spot on the posterior rays.

Given by Jordan and Evermann (Bull. 47) for Lake Erie; "two small specimens from the St. Mary's river at St. Mary's," Kirsch, 1893.

Opsopœodus megalops (Forbes).

Head $4\frac{3}{4}$; depth 4 to 5; eye $2\frac{3}{4}$. D. 7 or 8; A. 7 or 8; scales 5-39-4, 15 before dorsal. Teeth 5-5, hooked and crenate. Lateral line always incomplete, sometimes on 4 or 5 scales only; sometimes extending with interruptions to middle of caudal peduncle. Body slender, fusiform; mouth small, terminal, oblique, so much so in old specimens as to appear almost vertical, the chin projecting beyond mouth, in younger specimens the mouth is less oblique. Top of head covered with prickles in old males. Fins large, caudal deeply forked. Breast partly naked. Yellowish brown, sides silvery; scales above dark-edged. Dorsal fin with a black blotch on 4 anterior rays; a second black blotch usually present on 3 posterior rays. Length $2\frac{1}{3}$ inches.

I have given above the separation of *O. emiliæ* and *O. megalops* as given by Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) They suggest in regard to *O. megalops* that it is "perhaps not a distinct species." A comparative study of these forms confirms this belief. A dozen specimens taken by the writer in the headwaters of the Wabash river at Celina, August, 1899, and two from Summit lake at Akron, July 30, 1900, are referable to *O. megalops* as given above, but so many variations between

O. emilie and *megalops* exist among these specimens that it is possible to establish a graduated series between the two species, and none of the characters given in the above separation are found to be constant. The lateral line in some cases ceases in front of the dorsal fin, and in others is continuous to within two or three scales of the caudal. The second dorsal spot is also subject to great variation, for, while in old males it is distinct, in some cases it is very indistinct or wanting altogether. The fin formulæ and squamation of the breast also vary. Recently, through the kindness of Dr. S. E. Meek, I have been permitted to examine specimens of *O. emilie* from Indian Territory, Arkansas and Illinois, in the Field Columbian Museum at Chicago. These specimens show much the same variation as that given for *O. megalops*. As I have had no opportunity to compare with the type specimens, I hesitate to reduce *O. megalops* to synonymy, although the two species, as determined by Dr. Meek and myself, undoubtedly intergrade.

Genus: ABRAMIS.

Abramis crysoleucas (Mitchill). GOLDEN SHINER;
GOLDEN BREAM; ROACH.

Head $4\frac{1}{2}$; depth 3. D. 8; A. 13; scales 10-46 to 55-3; teeth 5-5. Body strongly compressed, the belly behind ventrals compressed into a sharp keel, over which the scales do not pass. Color, greenish above, the sides silvery, with bright golden reflections. Length about a foot.

The Golden Bream is an abundant resident of the state in suitable localities, being found chiefly in ponds, quiet pools and weedy bayous, apparently more common in the northern part of the state. Given by Rafinesque under the name *Notemigonus auratus* for the Ohio and Miami rivers; recorded by Kirtland under the name *Rutulus crysoleucas*; given by Jordan as "extremely abundant in every pond, lake or bayou"; Hamilton County, "common in Bloody Run and Clear creek," Henshall, 1888; Lorain County, "very common in still waters," McCormick, 1892; Maumee river at Cecil, Grand Rapids, Waterville and Toledo, St. Mary's river at St. Mary's and Rockford, Tiffin river at West Unity, Auglaize river at Oakwood and Defiance, Sugar creek and Lost creek at Lima, Blanchard river at Findlay,

Kirsch, 1893; Franklin County, Scioto river, Scioto Big Run, Big Walnut creek, Mason's Run, Big Darby creek, Hell Branch, Williamson and Osburn, 1897; Knox County, Big Jelloway creek, Parker, Williamson and Osburn, 1898; Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Chippewa lake, Licking reservoir, R. C. Osburn, 1900.

Genus: CLIOLA.

Cliola vigilax (Baird and Girard).

Head $4\frac{1}{4}$; depth $4\frac{1}{2}$; eye $3\frac{1}{2}$. D. 8; A. 7; scales 8-42-6, about 28 before dorsal; teeth 4-4, with grinding surface and slight hook. Superficially, much resembling *Pimephales notatus*, but the form is more stout, the mouth more terminal, and the alimentary canal less than twice the length of the body. Caudal peduncle quite deep. Color, greenish, sides pale, darker above, the scales above dark-edged; a dark lateral band ending in a distinct caudal spot; a well defined black spot on anterior rays of dorsal. Length 3 inches.

This minnow has, to the best of my knowledge, been recorded from but two localities in the state. It has been taken by Henshall in Hamilton County, "common in O'Bannon creek," and a single specimen was taken in Big Walnut creek, Franklin County, by Mr. E. B. Williamson and the writer in 1897. It is probably common nowhere in the state except in the southwestern part, as its range is for the most part farther south and west.

Genus: NOTROPIS.

Key to Species.

- A. Teeth 4-4, 1, 4-4, 0, or 1, 4-4, 1 (sometimes 2 teeth in one or both inner rows in *N. hudsonius* and *N. heterodon*).
- B. Scales not very closely imbricated, not notably deeper than long; dorsal inserted nearly over the ventrals; no black spot on dorsal fin.
- C. Teeth one-rowed, 4-4 (sometimes 2, 4-4, 2 in *N. heterodon*).
- D. Lateral line usually more or less incomplete; small species, usually with a dusky lateral band.
- E. Mouth very small, chin pale.— *cayuga*.
- EE. Mouth moderate; chin black.— *heterodon*.
- DD. Lateral line always complete; small, weak species.
- F. Fins all small and low, pectorals not reaching ventrals.— *blennius*.
- FF. Fins high, pectorals reaching ventrals.— *volucellus*.
- CC. Teeth two-rowed, 1, 4-4, 0; 1, 4-4, 1; or 1, 4-4, 2, the grinding surface more or less developed.
- G. No distinct dark spot at base of caudal.— *shumardi*.
- GG. A distinct dark spot present at base of caudal fin.— *hudsonius*.
- BB. Scales deeper than long, closely imbricated along side of body. Usually a distinct black spot on last rays of dorsal.— *whippilii*.
- AA. Teeth 2, 4-4, 2 (2, 4-4, 1 in *N. jejunus*).
- H. Anal fin short, of 7 to 9 developed rays.
- I. Teeth with the grinding surface developed.
- J. Scales closely imbricated along the sides, no dark spot at base of caudal.— *cornutus*.
- JJ. Scales not closely imbricated, a dark spot at base of caudal at least in young.
- K. 13 scales before dorsal fin.— *heterodon*.
- KK. 18 scales before dorsal.— *hudsonius*.
- II. Teeth without evident grinding surface, scales not closely imbricated.
- IL. Eye very large, $2\frac{3}{4}$ in head; teeth 2, 4-4, 2.— *arionomus*.
- LL. Eye $3\frac{3}{4}$ in head. teeth 2, 4-4, 1.— *jejunus*.
- HH. Anal fin long, of 11 or 12 rays; dorsal inserted behind ventrals.
- M. Scales not closely imbricated on sides, not crowded anteriorly.
- N. Eye very large, $2\frac{3}{4}$ to 3.— *arge*.
- NN. Eye smaller, $3\frac{3}{4}$ to 4.
- O. Front of dorsal midway between snout and base of caudal fin; eye $3\frac{3}{4}$ — *atherinoides*.
- OO. Front of dorsal nearer to base of caudal than to snout; eye 4.— *rubrifrons*.
- MM. Scales small and crowded anteriorly, closely imbricated; a black spot at base of caudal.— *umbratilis*.

Notropis cayuga Meek.

Head 4 or a little over; depth $4\frac{1}{2}$; eye $3\frac{1}{2}$. D. 8; A. 8; scales in lateral line about 36, 14 before dorsal; teeth 4-4. Close to *N. heterodon*, from which it can be distinguished most readily by the absence of any black on the chin. Lateral line wanting on some scales. Jaws nearly equal. A black band along lateral line, continued forward along sides of head and around snout on upper jaw. Length $2\frac{1}{2}$ inches.

First recorded for the state by Kirsch, 1893, "a few specimens from the Maumee river at Toledo"; Franklin County, "rare in Big Walnut and Little Darby creeks, common in Mason's Run," Williamson and Osburn, 1897; Sandusky Bay and Ashtabula creek at Ashtabula, common in both places, R. C. Osburn, 1899. This species seems to have been overlooked or confused with some other species by the earlier investigators, as its occurrence in both the Lake and Ohio river drainage at the points above noted would indicate a pretty general distribution over the state in suitable localities.

* **Notropis heterodon** (Cope).

Head 4; depth 4; eye 3, longer than snout. D. 8; A. 8; scales 5-36-3, 13 in front of dorsal. The lateral line incomplete, extending usually about to dorsal fin, but varying greatly; teeth 4-4 (sometimes 2, 4-4, 2). Body moderate; the back slightly elevated, dorsal inserted nearer the snout than base of caudal. Coloration olivaceous, darker on the back; a distinct lateral band, which passes forward through eye and on both jaws; chin distinctly black. Said to be an exceedingly variable species.

Taken by the writer in Sandusky Bay, July, 1899, and again in Sandusky Bay at Cedar Point and Black Channel, 1900.

Notropis blennius (Girard). STRAW-COLORED MINNOW.

D. 8; A. 8; scales 5-36-4, 14 in front of dorsal; teeth 4-4. Head 4; depth 4 to 5; eye large, 3 in head. Body moderately stout, but little compressed. Head rather broad; mouth small, inferior, horizontal. Lateral line complete. Dorsal fin low, its longest ray $\frac{3}{4}$ of head. Coloration, pale or yellowish olive; sometimes with a dark lateral band, and edges of mouth dark. Length $2\frac{1}{2}$ inches. An exceedingly variable Minnow.

This insignificant looking species occurs widely and abundantly throughout the state and has been recorded by all the recent writers upon the fishes of the state, beginning with Jordan (Ohio Rept.), under various names—*N. blennius*, *N. deliciosus* and *N. stramineus*. Hamilton County, "abundant in Little Miami river and Clough creek," Henshall, 1888; Lorain County, given as two species, *N. deliciosus*, very abundant in all the streams, and *N. stramineus*, not common, McCormick, 1892; Maumee river at

* *Notropis anogenus* Forbes and *N. fletensis* (Cope), two small species closely resembling *N. heterodon* and *N. cayuga*, respectively, have been taken almost on our borders in streams flowing into the state. They may be looked for in north-western Ohio. *N. anogenus* may be known from *N. heterodon* by the usually complete lateral line and the included lower jaw. *N. fletensis* is separated from *N. cayuga* (with which it is perhaps identical), by the complete lateral line and the presence of 17 scales in front of the dorsal.

Antwerp, Cecil, Defiance and Waterville, Tiffin river at Brunersburg, Auglaize river at Cloverdale, Sugar creek at Lima, Blanchard river at Ottawa, Beaver creek at Grand Rapids, Kirsch, 1893; Franklin County, common in almost every stream, females with eggs, July 16, Williamson and Osburn, 1897; Knox County, Big Jelloway creek system, "abundant, females with ripe eggs on May 25," Parker, Williamson and Osburn, 1898; Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, abundant in most places, R. C. Osburn, 1899; Pippin lake, Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Notropis volucellus (Cope).

Head $3\frac{3}{4}$; depth 4; eye $3\frac{1}{3}$. D. 8; A. 8; scales 4-34-3; teeth 4-4. Fins more elongate than in related species, the pectorals reaching ventrals. Very similar to *N. blennioides*, but distinguished especially by the noticeably higher fins. Length $2\frac{1}{2}$ inches.

The only record I am able to find of the occurrence of this species in Ohio is that given by Kirsch in his "Report upon Investigations in the Maumee River System," in which he mentions the fact that specimens from Gordon creek, taken by Prof. S. E. Meek, are given him as *Notropis deliciosus* var. *volucella* Cope. Cope's *volucellus* is now regarded as a distinct species.

Notropis shumardi (Girard).

Head $3\frac{3}{4}$; depth $4\frac{1}{2}$; eye very large, $2\frac{1}{3}$ to 3 in head. D. 8; A. 7 or 8; scales 4 or 5-36-2 to 4, 13 in front of dorsal; teeth 1, 4-4, 1, with deep grinding surface, and the edge strongly crenate. Body compressed, the back elevated; tail slender. Head compressed, flattened above, below and on the sides; snout short, obtuse; mouth very oblique, terminal, lower jaw included. Fins large. Lateral line complete, decurved. Color, olivaceous above, pale below; a dark lateral band, and vertebral line; scales above dark-edged. Length 3 inches.

Recorded by Kirsch as *N. boops* Gilbert, "common in the Maumee river at Grand Rapids," and "five specimens from the

Blanchard river at Findlay," 1893. Rare in Big Walnut creek, Franklin County, Williamson and Osburn, 1897; a single specimen from Stillwater creek near Dayton, R. C. Osburn, 1899.

Notropis hudsonius (De Witt Clinton). SPOT-TAILED MINNOW;
SHINER.

Head $4\frac{3}{4}$; depth 4; eye 3. D. 8; A. 8; scales 5-39-4, 18 before dorsal; teeth 1, 4-4, 0 or 1 or 2. Body elongate, considerably compressed in adult. Head short; muzzle blunt, decurved, shorter than the very large eye; mouth moderate, nearly horizontal, jaws sub-equal. Lateral line nearly straight, slightly decurved anteriorly. Coloration very pale, with a broad silvery band along side, this frequently underlaid with a dusky band. A dark spot at base of caudal, most distinct in young. Length 4 to 6 inches.

This species is apparently confined to the most northern portions of the state, in Lake Erie and its larger tributaries. Lorain County, "common in the lake and at the mouth of the rivers," McCormick, 1892; "very common in the Maumee river at Grand Rapids, a single specimen at Toledo," Kirsch, 1893; Lake Erie near Sandusky, abundant, R. C. Osburn, 1900; Sandusky Bay, Morse and Herbert T. Osborn, 1900.

Notropis whipplii (Girard). SILVER-FIN.

Head $4\frac{1}{4}$; depth 4 in adult males, females and young much slenderer; eye $4\frac{1}{2}$. D. 8; A. 8 or 9; scales 5 or 6-38 to 40-3 or 4; teeth 1, 4-4, 1. Body moderately elongate, compressed, the back and belly about equally arched. Head rather short and deep. Scales closely imbricated (much higher than wide) and of a very regular pattern, about 18 in front of dorsal. Color leaden or steel-blue, the sides silvery; a dark vertebral line; a black spot covering the posterior 3 membranes of the dorsal fin, this sometimes very much reduced in young and females, but always present. Breeding males have the fins tipped with creamy white, and the top of head and dorsal region in front covered with small prickles. Length 4 inches.

This elegant little fish is widely distributed throughout the state, and is usually quite common in all suitable localities. Recorded by Kirtland under the name *Luxilus kentukiensis*. Given by Jordan in his Ohio Report under the name *Hudsonius analostanus*, which he here confuses with *N. whipplii*. *Notropis* (*Hudsonius*) *analostanus* is an eastern form, possibly not specifically distinct from *N. whipplii* (see Jordan and Evermann, Bull. 47, U. S. Natl. Mus.) Hamilton County, common in all streams explored, Henshall, 1888; Lorain County, all streams examined,

but not very common, McCormick, 1892; taken throughout the Maumee river basin in Ohio, except in Gordon creek and the west end of Lake Erie, Kirsch, 1893; Franklin County, occurs abundantly in all the larger streams, females with ripe eggs June 28, Williamson and Osburn, 1897; Knox County, Big Jelloway creek and tributaries, not rare, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Notropis cornutus (Mitchill). COMMON SHINER; SILVERSIDES.

Head $3\frac{1}{4}$ to $4\frac{1}{4}$; depth about 3 ($2\frac{3}{4}$ to $3\frac{1}{2}$); eye $4-5\frac{3}{4}$. D. 8; A. 9; scales 6-41-3 or 4, closely imbricated, 18 or 20 before dorsal; teeth 2, 4-4, 2, with narrow grinding surface. Body varying much with age, in young slender, in adult short, deep and compressed. Lateral line decurved. Color above, dark olive green to steel-blue, sides silvery, with a brassy lateral band; a brassy vertebral line (this color showing only in fresh specimens, sometimes appearing as a dark line when out of water). Fins all plain, rosy tipped in breeding males. Females and young plainer. One of the most variable of our Minnows, varying with age, sex and season. Length about 10 inches.

One of the most abundant of fishes all over the state. Given by Kirtland as *Rutulus compressus* and *Luxulus chrysocephalus*; by Jordan as *Luxulus cornutus*. Hamilton County, as *Notropis megalops*, "abundant everywhere," Henshall, 1888; Lorain County, "very common everywhere," McCormick, 1892; Maumee river system, "every stream," Kirsch, 1893; Franklin County, "taken in every stream, generally abundant, females with eggs on July 6," Williamson and Osburn, 1897; Knox County, taken in every stream of the Big Jelloway creek system, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, and North Fork of Licking river at

Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Summit lake, Chippewa lake, Licking reservoir, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's creek at Bellaire, R. C. Osburn, 1900.

Notropis ariommus (Cope).

Head $3\frac{3}{4}$ to $4\frac{1}{4}$; depth $4\frac{1}{4}$ to 5. D. 8; A. 9; scales 6-39-2, large, 15 before dorsal; teeth 2, 4-4, 2. Body stout, moderately elevated, somewhat compressed. Head heavy, broad above; snout moderate, somewhat decurved; mouth moderate, oblique, jaws equal. Eye very large, $2\frac{1}{2}$ in head, much longer than snout, larger than in any other Ohio *Cyprinid*. Lateral line much decurved. Color olivaceous, scales above dark-edged; sides and below bright silvery. Length 5 inches.

Two specimens from the Maumee river at Antwerp, Kirsch, 1893.

***Notropis jejunus** (Forbes).

Head 4; depth $4\frac{2}{3}$; eye $3\frac{2}{3}$ in head, equal to snout, less than inter-orbital space. D. 8; A. 7; scales 5-37-3; teeth 2, 4-4, 1. Body moderately slender; head flattish above; snout blunt and rounded. Dorsal over ventrals; about 16 scales before dorsal. Color, pale olivaceous above, pale on sides and below, with a broad silvery band overlying a plumbeous shade. Length 3 inches.

The range of this species in the state seems to be limited to the Ohio river and the lower portions of its tributaries. Hamilton County, "common in Little Miami river and Bloody Run, Henshall, 1888; common in the Ohio river and Ice creek at Ironton and in John's creek at Waterloo, R. C. Osburn, 1899.

Notropis atherinoides Rafinesque.

Head $4\frac{2}{3}$; depth $5\frac{1}{2}$; eye $3\frac{1}{4}$. D. 8; A. 11; scales 5-38-3, 15 before dorsal; teeth 2, 4-4, 2. Body long and slender, compressed, back not elevated. Head blunt, conic, shorter than in related species. Mouth moderate, very oblique, upper lip on a level with upper part of pupil. Eye large, rather longer than snout. Fins low, front of dorsal midway between point of snout and base of caudal. Lateral line decurved. Color above clear, translucent olive-green, a yellow, iridescent vertebral line in life, which becomes darker in spirits; sides bright silvery, with sometimes a brassy lateral shade; breeding males with snout rosy. Length 4 to 6 inches.

* *Notropis scabriceps*, given by Jordan in the Ohio Rept., is confused probably with *N. shumardi*. *N. scabriceps* has not been noticed outside of the Kanawha river. (See Bull. 47, U. S. Natl. Mus.)

An elegant and graceful species, common and widely distributed, found in all larger streams, usually on gravelly or sandy bottom, and in lakes under the same conditions. Recorded for the state by Kirtland as *Minnilus dinemus*. "Exceedingly common in Lake Erie, and throughout the state one of the most abundant of minnows," Jordan (Ohio Rept.); Hamilton County, "common in Clough creek," Henshall, 1888; Lorain County, "very abundant at times," McCormick, 1892; Maumee river at Cecil, Grand Rapids and Toledo, St. Joseph river at Edgerton, Tiffin river at Brunersburg, Auglaize river at Wapakoneta and Cloverdale, "not common at any of these places," Kirsch, 1893; Franklin County, common in all of the larger streams, Williamson and Osburn, 1897; Knox County, "abundant in Big Jello-way creek," Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Sandusky Bay, Lake Erie at Sandusky, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Notropis arge (Cope).

Head $4\frac{1}{4}$; depth 6; eye $2\frac{3}{4}$ to 3. D. 8; A. 11; scales 5-39-3. Close to *N. atherinoides*, but the eye very large, longer than snout; lateral line nearly straight, head large, the snout not very blunt; mouth large, chin projecting. Color pale-greenish olive; a dark vertebral line; belly and sides pale; a broad, silvery lateral band bounded by a dark line. Length $3\frac{1}{2}$ inches. "Apparently varying into *N. atherinoides*, hence of doubtful validity."

This species has been taken at such points in the state as to indicate a wide distribution, but it is not generally common. Hamilton County, "common in east fork of Mill creek," Henshall, 1888; Lorain County, "in company with *N. atherinoides*, but not nearly as common," McCormick, 1892; Maumee river at Grand Rapids, St. Joseph river at Edgerton, Tiffin river at Brunersburg, scarce, Kirsch, 1893; Cuyahoga river at Hawkins, rare, R. C. Osburn, June 25, 1900.

Notropis rubrifrons (Cope).

Head 4 to 5' depth $4\frac{3}{4}$ to $5\frac{1}{2}$. D. 8; A. 10; scales 5 or 6-39 or 40-3, 15 to 17 before dorsal (Ohio specimens run a little higher, some having as high as 20 before the dorsal); teeth 2, 4-4, 2. Body moderately elongate, back scarcely elevated, head conic and rather pointed. Eye moderate, usually shorter than snout. Resembling *N. atherinoides*, from which it can be readily told, in Ohio specimens at least, by the position of the dorsal fin, which is inserted nearer to base of caudal than to point of snout. Above clear olive, each scale dark-edged; sides and under parts silvery; a narrow, coppery lateral band in life, overlying dark pigment; a narrow vertebral line; a row of black dots on either side of anal fin. Males in spring with head and anterior parts reddish, and sometimes the bases of dorsal, ventral and pectoral fins red. Length $2\frac{3}{4}$ inches.

A common and widely distributed species, found in company with *N. atherinoides*, but much more common. Kirsch and McCormick record it under the name *N. dilectus* (Girard), but *N. dilectus*, as now restricted, is found farther southwest, so I include these records under *N. rubrifrons*. Possibly the two may not be distinct. Given by Jordan as abundant in southern Ohio; Hamilton County, "common in east fork of Mill creek," Henshall, 1888; Lorain County, "common in the lake and lower parts of all streams entering it," McCormick, 1892; St. Joseph river at Edgerton, Blanchard river at Findlay, Beaver creek at Grand Rapids, "common at these places," Kirsch, 1893; Franklin County, "all larger streams with *N. atherinoides*, abundant where found," Williamson and Osburn, 1897; Knox County, Big Jelloway creek and several of its tributaries, occasionally observed in large schools over clear, gravelly places in ripples, females with ripe eggs on May 24, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Sandusky Bay, Lake Erie at Sandusky, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Kent and Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, outlet of Licking reservoir, R. C. Osburn, 1900.

Notropis umbratilis lythrurus (Jordan). REDFIN.

D. 7; A. 11; teeth 2, 4-4, 2; scales 9-45-3, crowded anteriorly. Head pointed, about 4 in length; body moderately elongated, compressed, depth 4 to 5. Eye $3\frac{1}{2}$. Color bright steel-blue above, pale below. Dorsal fin with a conspicuous black spot at base in front. Breeding males have the lower fins bright red. Females and young paler. Length 3 inches.

An exceedingly handsome species, especially during the breeding season. Widely distributed and generally common. Recorded for the state by Kirtland as *Scmotilus diplema*. Jordan gives it under the name *Lythrurus dipleminius* as "abundant throughout the state, especially in the southern part"; Henshall, Kirsch and McCormick record it under the name *N. ardens*; "abundant in all streams examined," in Hamilton County, Henshall, 1888; "found at all points explored in Maumee river system in Ohio except Maumee river at Cecil and Toledo, St. Joseph river at Edgerton and St. Mary's river at Rockford, Kirsch, 1893; Lorain County, "not very common, Black river and Vermillion river near Kipton," McCormick, 1892; Franklin County, "all streams but the smallest, abundant," June 15 given as a breeding date, Williamson and Osburn, 1897; Ice creek at Ironton, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark; exceedingly abundant in a small tributary of Ashtabula creek, in company with *Abramis crysoleucas*, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Breakneck creek near Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Bellaire, R. C. Osburn, 1900.

Genus: ERICYMBA.**Ericymba buccata** (Cope). SILVERY-JAWED MINNOW.

Head $6\frac{1}{2}$ to 4; depth $4\frac{1}{2}$ to 5; eye 4 to $4\frac{1}{2}$. D. 8; A. 7; scales 4 or 5-34-3, about 15 in front of dorsal; teeth 1, 4-4, 1 or 1, 4-4, 0, the inner slender and without grinding surface. Body rather elongate, little compressed, back not elevated. Head long, depressed above, with broad and prominent muzzle. Mouth small, horizontal, sub-inferior, lower jaw the shorter. Interopercle, suborbital and dentary bones containing mucous cavities,

which are visible externally. Color olivaceous above, pale and silvery on sides and below; a dark vertebral line and sometimes an indistinct, dark lateral band. Fins all plain. Length 3 to 5 inches.

Distributed throughout the state, a very common species, less abundant in the lake than in the Ohio river drainage. "Abundant in most streams tributary to the Ohio," Jordan's Report; Hamilton County, "abundant in Little Miami river and tributaries," Henshall, 1888; Lorain County, "taken once in Black river," McCormick, 1892; the Maumee river system in Ohio except at the following places: Maumee river at Cecil, Tiffin river at West Unity and Brunersburg, Auglaize river at Wapakoneta and Lost creek at Lima, Kirsch, 1893; Franklin County, every stream, generally abundant, June 15 given as a breeding date, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, "taken in every stream, abundant," Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, Huron river at Milan, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: RHINICHTHYS.

Key to Species.

- A. Snout long and prominent, projecting much beyond the mouth, barbel evident, no distinct, black lateral band.— *cataractæ*.
- AA. Snout shorter, little projecting, barbel small, but always present; a distinct, black lateral band.— *atronasus*.

***Rhinichthys cataractæ* (Cuvier and Valenciennes).**

LONG-NOSED DACE.

Head 4; depth 5; eye 2 in snout, 5 in head. D. 8; A. 7; scales small, 14-65-8; teeth 2, 4-4, 2. Resembling *R. atronasus*, from which it is distinguished by the longer head, by the prominent overhanging muzzle, much longer than in *atronasus*, by the longer barbels and by the absence of a distinct, dark lateral band. Color dark-brownish olive above, sometimes slightly mottled; paler below; a dark spot on opercle, but no distinct band through eye or along side. Length 5 inches.

Apparently a rare species in Ohio. Dr. Jordan (Ohio Rept.) says: "It is found in the tributaries of Lake Erie and even in the lake itself. It also occurs in the southeastern part of the state." Since then it has not been noticed by any other collector, and the writer has taken it but once, a single specimen from a small tributary of the Grand river near Painesville, August 2, 1900.

Rhinichthys atronasus (Mitchill). BLACK-NOSED DACE.

Head 4; depth $4\frac{1}{2}$; eye $1\frac{1}{2}$ in snout, $4\frac{1}{2}$ in head. D. 7 or 8; A. 7; scales 10-65-6; teeth 2, 4-4, 2. Body moderately elongate, little compressed. Head moderate, rather broad and flattish above; snout moderate; mouth horizontal, lower jaw included; barbels well marked in all Ohio specimens examined. Color above dark-yellowish olive, much blotched with black; a black lateral band passing forward through eye to snout; breeding males have the lateral band and the lower fins bright orange or crimson. All color markings less evident in females and young, but the lateral, dark band always present.

Distributed over the state and generally common or even abundant in suitable localities. It is essentially a "brook" species, being rarely found in larger streams, but swarming in clear, cold spring runs, in company with *Chrosomus erythrogaster*. Hamilton County, "common in all the streams," Henshall, 1888; Lorain County, "Spring brook and Chance creek, not common," McCormick, 1892; Maumee river system, "several from Lost creek near Cecil, by Prof. Meek, found nowhere else" (in Ohio), Kirsch, 1893; Franklin County, Grant's Run and Plum Run, common, Williamson and Osburn, 1897; Knox County, Little Jelloway creek, Parker's Run, Joe Sapp Run and Shadley Run, tributaries of Big Jelloway creek, common or abundant, May 24 given as a breeding date, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Wabash river at Celina, Wolf creek at Dayton, North Fork of Licking river at Newark, in all of these cases the species has been taken in small nameless tributaries rather than in the main stream, with the exception of Wolf creek and the Ohio river, R. C. Osburn, 1899; Cuyahoga river at Kent and Hawkins, and Breakneck creek near Kent, R. C. Osburn, 1900.

Genus: HYBOPSIS.

Key to Species.

- A. Mouth inferior, horizontal, color silvery.
- B. Teeth one-rowed, 4-4.
 - C. Eye $3\frac{1}{4}$ in head; no plumbeous blotches along lateral line.—*hyostomus*.
 - CC. Eye very large, $2\frac{3}{4}$: an interrupted plumbeous lateral band.—*dissimilis*.
- BB. Teeth two-rowed, 1, 4-4, 1, or 1, 4-4, 0.
 - D. Sides with a dusky lateral band.—*amblops*.
 - DD. Sides silvery, no lateral band.—*storerianus*.
- AA. Mouth large, nearly terminal; eye small; not silvery.—*kentuckiensis*.

Hybopsis hyostomus (Gilbert).

Head 4; depth $5\frac{1}{2}$; eye $3\frac{1}{4}$. D. 8; A. 8; scales in lateral line 37, 13 before dorsal. Body and head very slender; snout long, acute, projecting beyond mouth for half its length; mouth short, wide, inferior; barbels long. Color silvery, everywhere dusted with fine, dark specks. Length $2\frac{1}{2}$ inches.

Very rare in the state, and, as far as my knowledge goes, confined to the Ohio river. Dr. Henshall recorded it first from the Ohio river at Raccoon Island, 1889, and the writer has taken it twice in the Ohio, at Ironton, May 31, 1899, and at Bellaire, August 31, 1900.

Hybopsis dissimilis (Kirtland). SPOTTED SHINER.

Head $4\frac{1}{2}$; depth 5. D. 8; A. 7; teeth 4-4; scales 6-40 to 47-5, about 20 in front of dorsal. Body long and slender, little compressed, with long caudal peduncle. Head long, flattish above; snout somewhat bluntly decurved, a little projecting; mouth small, horizontal, lower jaw included; barbel smaller than in *H. amblops*; eye about 3 in head, somewhat directed upward. Color above dusky or olivaceous, somewhat mottled; sides silvery, with a bluish lateral band, which is sometimes widened into several blackish blotches. In full coloration, one of the most striking of our Minnows.

This species has been taken in a number of localities in Ohio, and in both the lake and Ohio river drainage, but is nowhere common. Recorded by Kirtland for the Mahoning river and Lake Erie near Cleveland; Hamilton County, "rather common in Little Miami river and O'Bannon creek," Henshall, 1888; Franklin County, "Big Walnut creek, rare," Williamson and Osburn, 1897; Stillwater creek near Dayton, rare, R. C. Osburn, 1899; Cuyahoga river at Hawkins, R. C. Osburn, 1900.

Hybopsis amblops (Rafinesque). SILVER CHUB.

Head 4; depth $4\frac{1}{2}$ to 5; eye 3. D. 8; A. 7 or 8; scales 5-38-4, about 14 before dorsal; teeth 1, 4-4, 1. Body rather slender, little compressed, rather heavy anteriorly. Head large, flattened and broad above; mouth subinferior, horizontal; barbel evident. Lateral line somewhat decurved. Color above clear translucent green, scales dark-edged; sides with a broad, silvery lateral band, overlying dark pigment, which sometimes appears as a dark lateral band; a dark band through eye around snout. Fins all plain. Length about 3 inches.

Common or abundant throughout the state, found in nearly all streams, but not taken in lakes. Recorded by Kirtland. Given by Jordan as abundant in tributaries of the Ohio; Hamilton County, "common in Little Miami river," Henshall, 1888; Lorain County, "common in some of the streams," McCormick, 1892; Maumee river system, "all the smaller tributaries," Kirsch, 1893; Franklin County, common in all but the smallest streams, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, abundant, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river near Newark, R. C. Osburn, 1899; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Wiloughby, Wheeling creek at Bridgeport, Ohio river and McMahon's creek at Bellaire, R. C. Osburn, 1900.

Hybopsis storerianus (Kirtland).

Head $4\frac{1}{2}$; depth 4; eye 3, equal to snout. D. 8; A. 8; scales 5-42-4. Body elongate, somewhat compressed, the back somewhat elevated. Head short, compressed; preorbital bone large and silvery; mouth horizontal, lower jaw included; barbels conspicuous. Lateral line somewhat decurved. Dorsal inserted over ventrals, ventrals not reaching vent, caudal long, deeply forked. The teeth are said to be usually 1, 4-4, 0, but all Ohio specimens examined have the teeth 1, 4-4, 1. Translucent greenish above, elsewhere bright silvery, sides with a slight plumbeous lateral band, no caudal spot. Length 5 to 10 inches.

Apparently not well distributed over the state, though occurring in both the Lake Erie and the Ohio river drainage. Lake Erie, Kirtland; "abundant in Lake Erie," Jordan; Hamilton

County, "common in Little Miami river and Clough creek," Henshall, 1888; Lorain County, Beaver creek and Lake Erie, McCormick, 1892; Lake Erie near Sandusky, R. C. Osburn, 1900. Dead ones are frequently thrown upon the beach by the waves at Sandusky; not noticed in Sandusky Bay.

Hybopsis kentukiensis (Rafinesque). HORN-Y-HEAD;
RIVER CHUB; JERKER; INDIAN CHUB.

Head $3\frac{3}{4}$ to 4; depth 4 to $4\frac{1}{4}$; eye $5\frac{1}{4}$. D. 8; A. 7 or 8; scales 6-41-5, about 18 before dorsal; teeth 1, 4-4, 1 or 1, 4-4, 0, sometimes 4-4, in all Ohio specimens examined they are 1, 4-4, 1. Body rather robust, little elevated, little compressed. Head large, broadly rounded above; snout conical, bluntish; mouth large, nearly terminal; barbel evident. Dorsal inserted slightly behind ventrals. Color dusky or bluish or greenish olive above, sometimes with brassy luster, pale but not silvery below; sometimes with a clear, grass green lateral band in life; fins all plain, tinged with dull orange. Breeding males have the belly tinged with rosy, and a crimson spot on side of head behind eye, and have the top of the head swollen into a crest which is covered with tubercles. Young with dark caudal spot. Length 6 to 9 inches.

Well distributed over the state and generally common. Recorded by Kirtland. "Every stream in the state of Ohio," Jordan; Hamilton County, "Little Miami river," Henshall, 1888; Lorain County, "very common in larger streams," McCormick, 1892; Maumee river system in Ohio, "every point in every stream examined," Kirsch, 1893; Franklin County, common in larger streams, July 16 given as breeding date, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, abundant, May 23 noted as a breeding date, Parker, Williamson and Osburn, 1898, Ohio river at Iron-ton, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking River at Newark, R. C. Osburn, 1899; Cuyahoga river at Kent and Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: EXOGLOSSUM.

Exoglossum maxillingua (Le Sueur). CUT-LIPS; NIGGER CHUB.

Head 4; depth $4\frac{1}{2}$. D. 8; A. 7; scales 8-53-5; teeth 1, 4-4, 1. Body rather stout, little compressed. Head broad and flattish above, with tumid cheeks. Mouth peculiar, the mandible being contracted and incurved, its

outline 3-lobed; this appearance is due to the fact that the dentary bones lie close together, parallel, and are united throughout their length, instead of forming an arch as in all other *Cyprinidæ*; lower lip represented by a broad, fleshy lobe on either side of the mandible. Color olivaceous, smoky or dark above; a blackish bar behind opercle, and a dusky shade at base of caudal in young. Fins all plain. Length 6 inches.

Rare in Ohio. Six specimens were taken by the writer in Stillwater creek near Dayton, Aug. 15, 1899. The range of the species is to the eastward. West of the Alleghenies it has heretofore been known only from the Kanawha river, West Virginia.

Order: APODES.

Sub-Order: ENCHELYCEPHALI.

Family: ANGUILLIDÆ.

Genus: ANGUILLA.

***Anguilla chrysypa* Rafinesque. AMERICAN EEL;
FRESHWATER EEL.**

Body elongate, compressed behind; appearing scaleless, but covered with fine, imbedded scales. Head long, conical, moderately pointed. Dorsal and anal fins confluent with caudal. Color brown, often tinged with yellowish; paler below, the color quite variable. Length 4 or 5 feet.

The Eel appears to be nowhere very common in Ohio, but is widely distributed throughout the state, and probably occurs in every lake, reservoir and large stream. Rafinesque mentions its occurrence in the Ohio "as far as Pittsburg;" Kirtland records it for the Ohio river drainage; Lake Erie and Ohio river, Henshall, 1889; Lorain County, "occasionally taken in the pounds," McCormick, 1892; Maumee river at Defiance, "said to inhabit all waters of the Maumee basin," Kirsch, 1893; Franklin County, observed in Big Walnut creek, reported by fishermen as "not rare," Williamson and Osburn, 1897; Pippin lake and Chippewa lake, R. C. Osburn, 1900. I have seen specimens taken in Licking reservoir, Licking river and North Fork of Licking river. According to Kirtland the Eel did not formerly inhabit the Lake Erie drainage, but if not, it has found its way there through the canals.

Order: ISOSPONDYLI.*Family:* HIODONTIDÆ.*Genus:* HIODON.*Key to Species.*

- A. Belly in front of ventrals carinated; dorsal with 9 developed rays.— *alosoides*.
AA. Belly in front of ventrals not carinated; dorsal of 11 or 12 developed rays.— *tergisus*.

Hiodon alosoides (Rafinesque).

Head $4\frac{1}{2}$; depth $3\frac{1}{2}$; eye $3\frac{1}{2}$. D. 9; A. 32; scales 6-56-7. Body closely compressed, becoming deep in the adult, the ventral edge everywhere carinated. Maxillary reaching middle of eye. Caudal peduncle rather stouter than in *H. tergisus*, and the fin not so deeply forked; also, the pectorals are longer and the ventrals shorter than in *H. tergisus*. Color bluish, sides silvery, with golden luster. Length 12 inches.

Rare in Ohio, the range of the species being farther to the west. A single specimen, taken in a fisherman's net in the Ohio river, was recorded by Henshall for Hamilton County, 1888.

Hiodon tergisus Le Sueur. MOON EYE; TOOTHED HERRING.

Head $4\frac{1}{3}$; depth 3; eye 3. D. 12; A. 28; scales 5-55-7. Body oblong, moderately compressed. Eye large, the maxillary barely reaching its middle. Pectoral fins not reaching ventrals, the latter just short of vent. Belly somewhat carinated behind ventrals only. Color brilliantly silvery, olive-shaded above. Length 12 inches.

This species is confined to Lake Erie and the Ohio river, and the lower courses of their larger tributaries, but it is common where found. Rafinesque made four species of it, and reported two of them for the Ohio as far as Pittsburg. Three of these nominal species, *H. dodalus*, *H. vernalis* and *H. tergisus*, were recognized by Kirtland in his 1838 report, but he afterward dropped all but *H. tergisus*. "Common in the Ohio," Henshall, 1888; Lorain County, "common in the lake, ascending the streams sometimes," McCormick, 1892; "below the dams in the Maumee river at Defiance and Grand Rapids, at both places they were very abundant," Kirsch, 1893; Ohio river at Bellaire, R. C. Osburn, 1900.

Family: DOROSOMIDÆ.

Genus: DOROSOMA.

Dorosoma cepedianum (Le Sueur). GIZZARD SHAD.

Head $4\frac{1}{3}$; depth $2\frac{1}{2}$; eye $4\frac{1}{2}$. D. 12, its last ray prolonged and filiform, about as long as head; scales 56-23. Body deep, compressed, the back elevated in adult; belly compressed to an edge, serrated and covered by scutes, 17 in front of vent, 12 behind. Mouth small, inferior, no teeth. An adipose eyelid. No lateral line. Stomach short, muscular, like the gizzard of a fowl. Caudal fin widely forked, lower lobe the longer. Color silvery-bluish above; young with a round, dark spot at shoulder; tips of ventrals and edge of anal often dusky. Length 15 inches.

This handsome, worthless species is now well distributed over the state in the lake and larger streams, although it is said that previous to the opening of the canals it was not found in the lake drainage. The form resident in the Mississippi valley is known as var. *heturum*. Given by Kirtland as *Chatoessus ellipticus*. Ohio river, Lake Erie and Licking reservoir, Jordan's Report; Hamilton County, "very common in the Ohio river," Henshall, 1888; Lorain County, "quite common in the lake and ascending the rivers," McCormick, 1892; Maumee river at Defiance and Grand Rapids, St. Mary's river at St. Mary's and Rockford, Tiffin river at Brunersburg, Auglaize river at Cloverdale, Oakwood and Defiance, Hoaglin creek near Oakland and Gordon creek near Cecil, Kirsch, 1893; abundant in St. Mary's reservoir and in the wasteway of the St. Mary's reservoir into the headwaters of the Wabash river at Celina, R. C. Osburn, 1899; Chippewa lake, Ohio river at Bellaire and Licking reservoir, very abundant at the last place, R. C. Osburn, 1900.

Family: CLUPEIDÆ.

Genus: POMOLOBUS.

Pomolobus chrysochloris Rafinesque. SKIPJACK; BLUE HERRING.

Head $3\frac{3}{4}$; depth $3\frac{3}{4}$; eye shorter than snout, large, well covered by an adipose eyelid, $4\frac{1}{3}$ in head. D. 16, its posterior ray not prolonged; A. 18; about 52 scales in lateral line. Body elliptical, much compressed; belly compressed to an edge which is covered with scutes, 20 before vent, 13

behind. Head slender and pointed; lower jaw strongly projecting; upper jaw emarginate. Color, brilliant blue above, sides silvery with golden reflections; no dark spot behind opercle. Length 15 inches.

This is a deep water species, common in the Ohio river, and it has made its way through the canals into Lake Erie, where it is now said to be common. Ohio river, "seldom as far as Pittsburgh," Rafinesque; "very rare, two specimens seen in Cincinnati market," Kirtland, 1838; Hamilton County, "abundant in Ohio river," Henshall, 1888.

Family: SALMONIDÆ.

Key to Genera.

- A. Mouth not deeply cleft; dentition feeble or incomplete, scales large.
 - B. Lower jaw short and more or less included, cleft of mouth short.—
COREGONUS.
 - BB. Lower jaw long, projecting beyond upper, cleft of mouth rather long.—
ARGYROSOMUS.
- AA. Mouth deeply cleft; dentition strong and complete, scales small.
 - C. Vomer with raised crest, which is armed with strong teeth; hyoid bone with a broad band of strong teeth; no bright colors.—
CRISTIVOMER.
 - CC. Vomer without raised crest; hyoid with weak teeth or none; spotted with red.—
SALVELINUS.

Genus: COREGONUS.

Coregonus clupeiformis (Mitchill). COMMON WHITEFISH.

Head 5; depth 3 to 4; eye 4 to 5. D, 11; A, 11; scales 8-74 to 85-9. Body oblong, compressed, always elevated, especially so in adult. Head comparatively small and short; the snout obliquely truncated. Gill rakers numerous, long and slender. Color olivaceous above; sides white, but not silvery; lower fins sometimes dusky. Length 2 feet or more.

In Ohio the Whitefish is found only in Lake Erie, where it occurs in great numbers. It does not ascend streams. Recorded first by Kirtland. "The most important fish of Ohio, both as to quantity taken and quality as food," Jordan's Report; L. Erie, Henshall, 1889; "common in the lake," McCormick, 1892; "west end of Lake Erie," Kirsch, 1893. Great quantities from various parts of the lake are brought into the fish houses at Sandusky.

Genus: ARGYROSOMUS.*Key to Species.*A. Lower jaw projecting; depth in length $4\frac{1}{2}$.—*artedi.*AA. Jaws about equal; depth in length 3 to $3\frac{1}{2}$.—*tullibee.***Argyrosomus artedi** (Le Sueur). CISCO; LAKE HERRING.

Head $4\frac{1}{2}$; depth $4\frac{1}{2}$; eye 4 to $4\frac{1}{2}$. D. 10; A. 12; scales 8-75 to 90-7. Body elongate, compressed, not elevated. Head compressed, rather long; distance from occiput to snout usually a little less than half the distance from occiput to insertion of dorsal fin. Dorsal fin high, its rays rapidly shortened. Bluish black or greenish above; sides silvery, with dark specks; fins mostly pale, the lower dusky-tinged. Length 1 foot.

In Ohio taken only in Lake Erie, where it is very abundant. Recorded by Kirtland, Jordan and Henshall. Lorain Co., "very abundant, sometimes filling the pound nets almost solid with fish," McCormick, 1892; "west end of Lake Erie," Kirsch, 1893. Brought into Sandusky fish houses in enormous numbers.

Argyrosomus tullibee (Richardson). TULLIBEE; MONGREL WHITEFISH.

Head 4 to $4\frac{1}{2}$; depth 3 to $3\frac{1}{2}$; eye $4\frac{1}{2}$, as long as snout. D. 11 or 12; A. 11; scales 8 or 9-67 to 74-8. Body short, deep, compressed, shad-like, dorsal and ventral curves similar. Head conic, compressed; distance from occiput to tip of snout half the distance from occiput to insertion of D. Color bluish above; sides white, punctate with fine dots; each scale with a silvery area, these forming a series of distinct longitudinal stripes. Length 18 inches.

I have seen but one record of this species in Ohio, as follows: "I once received a photograph of a Tullibee from Dr. E. Sterling, of Cleveland. The specimen had been taken in Lake Erie," Jordan's Report.

Genus: CRISTIVOMER.**Cristivomer namaycush** (Walbaum). MACKINAW TROUT; GREAT LAKE TROUT; NAMAYCUSH.

Head $4\frac{1}{4}$; depth 4; eye large, $4\frac{1}{2}$. D. 11; A. 11; lateral line 185 to 205. Body elongate. Head very long and pointed, its upper surface flattened. Mouth very large, the maxillary extending much beyond eye; teeth strong. Caudal fin well forked; adipose fin small. General color dark gray, varying from pale to nearly black; everywhere with rounded, paler spots, which are often reddish tinged; dorsal and caudal reticulate with darker. Length 3 feet.

In Ohio taken only in Lake Erie, does not ascend streams. Kirtland records it for Lake Erie, "a few stragglers are taken." Jordan and Henshall also record it. McCormick says of its occurrence in Lorain County, "very rare, it is almost unknown to the fishermen here, though common in the eastern part of the lake."

Genus: SALVELINUS.

Salvelinus fontinalis (Mitchill). SPECKLED TROUT; BROOK TROUT.

Head $4\frac{1}{2}$; depth $4\frac{1}{2}$. D. 10; A. 9; scales 37-230-30. Body oblong, moderately compressed, not much elevated. Head large, but not very long, the snout bluntish; mouth large, the maxillary reaching more or less beyond eye; eye large. Color above more or less mottled with dark olive or black; sides in life with many red spots; dorsal and caudal mottled or barred with dark; belly in males often more or less red.

The Brook Trout now probably occurs in but one stream in the state. Castalia creek, near Sandusky. In 1838 Kirtland recorded the species as found "in only two streams, a small creek in Ashtabula County, and a branch of the Chagrin river in Geauga County." In 1889 Henshall recorded it for Castalia creek. It still occurs there in numbers under the protection of a fishing club, which, I understand, introduces young fry to keep up the supply.

Order: HAPLOMI.

Family: UMBRIDÆ.

Genus: UMBRA.

Umbra limi (Kirtland). MUD MINNOW.

Head $3\frac{3}{4}$; depth $4\frac{1}{4}$. D. 14; A. 8; scales 35-15, soft and leathery; no lateral line. Body oblong, compressed. Head large, shortish, cheeks and opercles and top of head forward to between the eyes, covered with scales. Caudal fin conspicuously rounded. Color dull olive green, with a dark dorsal band and about 14 light vertical bars, less distinct in young. A dark bar at base of caudal. Length $4\frac{1}{2}$ inches.

This species is rare in the Ohio river drainage, but is reported as very common in the northern part of the state. Recorded for streams of northern Ohio by Kirtland; abundant in the northern part of Ohio, Jordan's Report; Lorain County, "very common in sloughs and bayous." McCormick, 1892; Fish creek at Edger-

ton, Lost and Gordon creeks near Cecil, "very common on soft muddy bottom," Kirsch, 1893; a single specimen was taken April 3, 1897, in a small tributary of the Olentangy river at Columbus by Mr. E. B. Williamson and the writer; Niggermill Run at Salem, E. B. Williamson, 1900; abundant in the "Black Channel" in Sandusky Bay, R. C. Osburn, 1900.

Family: LUCIIDÆ.

Genus: LUCIUS.

Key to Species.

- | | | |
|-----|---|----------------------|
| A. | Opercles entirely scaled, scales in lateral line 105.— | <i>vermiculatus.</i> |
| AA. | Opercles with the lower half bare of scales. | |
| B. | Cheeks entirely scaled, scales in lateral line about 123.— | <i>lucius.</i> |
| BB. | Cheeks with the lower half bare of scales, scales in lateral line about 150.— | <i>masquinongy.</i> |

Lucius vermiculatus (Le Sueur). LITTLE PICKEREL; GRASS PIKE.

Head long, $3\frac{1}{4}$ to $3\frac{3}{4}$ in length of body; depth 5 to 6; eye 6 in head, large. D. 11 or 12; A. 11 or 12; scales 105. Body elongate, somewhat compressed. Opercles and cheeks entirely covered with scales. Color greenish or grayish olive, everywhere reticulated with irregular, light markings; the color extremely variable. Length about a foot.

The Little Pickerel, or "Grass Pike," as it is sometimes called, is common throughout the state in suitable localities. Its favorite haunt is the weedy pond or backwater or overflow pool of some stream, and in such places it is sometimes very abundant. Jordan in his Ohio Report gives it as more abundant in the Ohio river drainage than in that of the lake. "Lake Erie and Maumee river," Henshall, 1889; Lorain County, "common," McCormick, 1892; "common throughout the Maumee basin, all waters examined (in Ohio) except Hoaglin creek," Kirsch, 1893; Franklin County, "of general distribution, abundant in Hell Branch," Williamson and Osburn, 1897; John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, R. C. Osburn, 1899; Sandusky Bay, Breakneck creek near Kent, Licking reservoir, R. C. Osburn, 1900.

Lucius lucius (Linnaeus). PICKEREL; PIKE.

Head $3\frac{1}{3}$; depth 5; eye $6\frac{1}{3}$ in head. Developed rays of dorsal 16 or 17, of anal 13 or 14; scales 123. Body moderately elongate, back little elevated. Head rather long. Cheeks scaly; the lower half of opercle bare. Color

bluish or greenish gray, with many whitish or yellowish spots arranged somewhat in rows. Dorsal, anal and caudal fins with roundish or oblong, black spots. Length 4 feet.

The Pickerel is said to have been very abundant at one time in all the streams flowing into Lake Erie and somewhat less common in the Ohio river drainage. In the latter it has now, as far as Ohio is concerned, become quite rare, and in the lake drainage, and even in the lake itself, it has noticeably diminished in numbers. Kirtland gives it as "common both to the waters of the Ohio and the lake." Lake Erie and Sandusky river, Henshall, 1889; Lorain County, Lake Erie and Black river, "often killed in the ponds and channels of the snipe ground when they are spawning," McCormick, 1892; St. Joseph river at Edgerton, Tiffin river at West Unity and Brunersburg, Auglaize river at Cloverdale, Kirsch, 1893; Sandusky Bay, R. C. Osburn, 1899; Licking reservoir, a single specimen, 1½ feet in length. R. C. Osburn, 1900.

Lucius masquinongy (Mitchill). MUSKALLUNGE.

Head $3\frac{2}{3}$; depth 6; eye 4 to 6 in snout. D. 17; A. 15; scales 150. General form of *L. lucius*; the head proportionately longer. Cheeks and opercles both naked below. Color dark gray, sides in the typical form, *masquinongy*, with round or squarish, blackish spots of varying size on a ground color of grayish silvery; belly white; fins spotted with black. Length 4 to 8 feet.

This magnificent Pike is represented in Ohio by two varieties, as follows: *L. masquinongy* var. *masquinongy*, the typical form, confined to Lake Erie and its tributary rivers, and *L. Masquinongy ohioensis* (Kirtland), confined to the Ohio river and its tributary streams. The variety *ohioensis* is separated from the typical form by the presence of narrow irregular crossbars, formed by the coalescing of spots on the sides. Kirtland records the former for Lake Erie and the Ohio canal near Massilon, 1838, and the latter for the Mahoning river, 1854; Ohio river and Lake Erie, Henshall, 1889; McCormick records the species for Lorain County, and states that it is growing rare, being seldom taken in the pounds; Kirsch, in 1893, speaks in the same strain of their diminishing numbers in Maumee river and the west end of Lake Erie.

Family: PÆCILIIDÆ.

Genus: FUNDULUS.

Key to Species.

- | | | |
|-----|--|-------------------|
| A. | No broad, black lateral band. | |
| B. | Dorsal fin of 12 or 13 rays.— | <i>diaphanus.</i> |
| BB. | Dorsal fin of 7 rays.— | <i>dispar.</i> |
| AA. | A broad, black lateral band, its edges notched; dorsal fin of 9 rays.— | <i>notatus.</i> |

Fundulus diaphanus menona (Jordan and Copeland).

Head $3\frac{1}{2}$; depth 5. D. 12; A. 10; scales 48-12. Body rather slender, not elevated, compressed posteriorly. Head flattened above. Fins rather small and low. General color olivaceous, below pale, sides somewhat silvery; back always spotted; sides with about 16 distinct, irregular, dark bands, these often replaced by the same number of shining, silvery bands narrower than the interspaces. Length $3\frac{1}{2}$ inches.

Taken only in the northern part of the state, where in suitable places it is common. "Taken once near Lorain, common near Huron and Put-in-Bay," McCormick, 1892; "Maumee river at Toledo, abundant," Kirsch, 1893; noted commonly by Prof. D. S. Kellicott, E. B. Williamson and the writer in Sandusky Bay in 1896, and again by the writer in 1899 and 1900.

Fundulus dispar (Agassiz).

Head $3\frac{3}{4}$; depth $3\frac{1}{2}$. D. 7; A. 9; scales 35-10. Body short and deep, much compressed. Head short and very broad, the distance between the eyes above greater than the distance between them below. Snout broadly rounded. Dorsal fin much smaller than anal. Color pale olive, bluish in life; about 10 longitudinal, wavy, brown stripes along sides formed by the dark edges of the scales. Males have these stripes interrupted and have about 9 dark crossbars; a black blotch below eye. Length $2\frac{1}{2}$ inches.

Given for Ohio by Jordan (Ohio Rept.), and Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) Dr. B. W. Evermann, in a recent letter regarding this species, says: "I learned of its occurrence in the Celina reservoir through students of mine who seined there. No record was published, however."

Fundulus notatus (Rafinesque). TOP MINNOW.

Head 4; depth $4\frac{1}{2}$; eye 3. D. 9; A. 11 or 12; scales 34-11. Body slender, compressed posteriorly. Head depressed, rather long, the snout somewhat produced; interorbital space half the length of head. Color olivaceous or brownish olive, with a broad, blackish lateral band from tip of

snout to caudal, this band usually notched above and below, giving it a serrated appearance. A light, translucent spot is conspicuous on the top of the head when the fish is swimming at the surface. Length 2 to $3\frac{1}{2}$ inches.

The Top Swimmer is a common species in suitable localities in the Ohio river drainage, but is rather rare in the tributaries of the lake. Hamilton County, very abundant in Ross lake, Henshall, 1888; Maumee river at Grand Rapids, St. Mary's river at St. Mary's and Rockford, Tiffin river at West Unity and Brunersburg, Auglaize river at Wapakoneta, Cloverdale, Oakwood and Defiance, Blanchard river at Ottawa, Hoaglin creek at Ottawa, "seemingly scarce at all these points," Kirsch, 1893; Franklin County, of general distribution, abundant in places, Williamson and Osburn, 1897; Wabash river at Celina, Stillwater creek near Dayton, very common, R. C. Osburn, 1899.

Order: HEMIBRANCHII.

Family: GASTEROSTEIDÆ.

Genus: EUCALIA.

***Eucalia inconstans* (Kirtland). BROOK STICKLEBACK.**

Head $3\frac{1}{2}$; depth 4. D. IV-I, 10; A. I, 10. Body moderately elongate, little compressed; caudal peduncle slender, not keeled. Dorsal spines low, subequal, 4 or 5 in number in a right line; a cartilaginous ridge along base of fin; ventral spines short and sharp, serrated. Color, males in spring jet black, tinged with red anteriorly; females and young, olivaceous, mottled and dotted with black. Length $2\frac{1}{2}$ inches.

This species is probably confined to the central and northern parts of Ohio. It is said to be abundant in some localities. Kirtland described the species in 1841, from brooks of Trumbull County; Jordan gives it as "abundant in many streams in northern part of Ohio"; "Castalia creek" near Sandusky, Henshall, 1889; Lorain County, "I have found sticklebacks in but two places," McCormick, 1892; Mr. E. B. Williamson writes me that he has found the species in Niggermill Run at Salem, Columbiana County, 1899.

Order: ACANTHOPTERI.

Sub-Order: SALMOPERCÆ.

Family: PERCOPSIDÆ.

Genus: PERCOPSIS.

***Percopsis guttatus* Agassiz. TROUT PERCH.**

Head $3\frac{1}{2}$ to 4; depth 4 to $4\frac{1}{2}$. D. II, 9; A. I, 7; scales about 50, strongly ctenoid. Head rather long, slender and conical, mouth subinferior. Body rather slender; caudal peduncle long and slender. A small but distinct adipose fin behind dorsal. Color, pale olivaceous on back, colorless and somewhat translucent below; about 11 small, dark spots along lateral line, and another row of smaller dots between this and mid-dorsal line. Length 4 to 6 inches.

Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) in discussing the range of this species give it as "rare in streams south of Lake Erie." This statement does not seem to hold good for the State of Ohio, for in suitable localities the species is common as far as the southern limits of the state, and in some places is very abundant. Hamilton County, "abundant in Little Miami river below the dam at Loveland," Henshall, 1888; Lorain County, "common in Lake Erie, Black river and Beaver creek," McCormick, 1892; Franklin County, taken in most of the streams of the county, abundant in streams west of the Scioto, after some hauls in Scioto Big Run the seine contained more of this than all the other species combined, Williamson and Osburn, 1897; John's creek at Waterloo, Huron river at Milan, common at both places, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900.

Sub-Order: XENARCHI.

Family: APHREDODERIDÆ.

Genus: APHREDODERUS.

***Aphredoderus sayanus* (Gilliams). PIRATE PERCH.**

Head 3; depth 3. D. III, 11 to IV, 10; A. II, 6; scales 45 to 60. Body oblong, elevated at base of dorsal, compressed behind. Head thick, depressed; mouth moderate, lower jaw projecting. Lateral line imperfect or wanting. The position of the anus is peculiar, being always anterior; it

varies in position with age from just behind the ventrals in the young, to below the preopercle in the adult. Color, dark olive, profusely speckled with dark points, which may form streaks along the rows of scales; 2 blackish bars at base of caudal. Length 5 inches. The Ohio form is the variety *isolepis*.

The Pirate Perch seems to be a rather rare species in Ohio, and thus far it has been taken only in Lake Erie and the Maumee river system. "Lake Erie," Henshall, 1889; Maumee river system, "only two small specimens were taken, one by Prof. Meek in Gordon creek near Cecil, and one by us in warm sluggish water in St. Mary's river at Rockford," Kirsch, 1893.

Sub-Order: PERCESOCES.

Family: ATHERINIDÆ.

Genus: LABIDESTHES.

Labidesthes sicculus Cope. BROOK SILVERSIDES.

Head $4\frac{1}{4}$ to $4\frac{1}{2}$; depth 6; eye large, $3\frac{1}{2}$. D. IV-I, 11; A. I, 23; scales 75. Body very long and slender, compressed. Head long, flattened above; snout long, slender and conic; mouth very large, the jaws produced into a sort of beak. First dorsal very low, inserted well back; caudal forked. Color pale olive green, translucent, dotted above with fine, dark specks; a broad, distinct, silvery lateral band, bounded above by a dark line. Length $3\frac{1}{2}$ inches.

This peculiar and interesting little fish is widely distributed over the state and is generally common. Quiet pools of streams and shallow waters of lakes on sandy or gravelly bottom are its favorite haunts. Hamilton County, "one specimen from Bloody Run, common in Ross lake," Henshall, 1888; Lorain County, "quite common in the lake and in the larger streams below the dams," McCormick, 1892; "generally distributed in the waters of the Maumee basin," Kirsch, 1893; Franklin County, generally distributed, abundant, Williamson and Osburn, 1897; Huron river at Milan, Sandusky Bay, Wabash river at Celina, Stillwater creek near Dayton, very abundant on sandy bottom in shallow water in Sandusky Bay, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Pippin lake, Chippewa lake, Summit lake, Grand river at Painesville, Chagrin river at Willoughby, Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Sub-Order: RHEGNOPTERI.*Group:* PERCOIDEA.*Family:* CENTRARCHIDÆ.*Key to Genera.*

- A. Dorsal fin scarcely longer than anal.— POMOXIS.
 AA. Dorsal fin much larger than anal.
 B. Body comparatively short and deep, the depth usually more than $\frac{2}{3}$ the length.
 C. Tongue and pterygoids with teeth; mouth large, maxillary reaching past middle of eye.
 D. Opercle emarginate behind; anal spines 6.— AMBLOPLITES.
 DD. Opercle ending in a black, convex process or flap; anal spines, 3.— CHÆNOBRYTTUS.
 CC. Tongue and pterygoids toothless; mouth small, maxillary barely reaching past middle of eye.
 E. Supplemental bone of maxillary perfectly distinct.— APOMOTIS.
 EE. Supplemental bone of maxillary rudimentary or wanting.
 F. Lower pharyngeal bones narrow, the teeth usually sharp, not conical.— LEPOMIS.
 FF. Lower pharyngeals broad and concave, especially in the adult, teeth more or less blunt and paved.— EUPOMOTIS.
 BB. Body comparatively elongate, depth in adult about $\frac{1}{3}$ the length; mouth large.— MICROPTERUS.

Genus: POMOXIS.*Key to Species.*

- A. Dorsal spines 6, occasionally 5, rarely 7; profile strongly sinuate, anal fin plain.— *annularis*.
 AA. Dorsal spines 7, rarely 8; profile not strongly sinuate; anal fin reticulate with dark markings.— *sparoides*.

Pomoxis annularis Rafinesque. CRAPPIE; LAKE ERIE BASS;
 CALICO BASS.

Head 3; depth $2\frac{1}{3}$; eye large, 4. D. V or VI, or sometimes VII, 15; A. VI, 18; scales 6-48-14. Body elongate, much compressed. Head long; the profile from snout to dorsal strongly sinuate; mouth very wide. Fins very high, but lower than in *P. sparoides*. Color, silvery olive, mottled with dark green, the dark marks chiefly on upper part of body and having a tendency to form vertical bars; dorsal and caudal marked with dark green, anal nearly plain. A lighter colored fish than *P. sparoides*. Quite variable. Length 12 inches.

Well distributed over the state in larger streams and lakes, common. Recorded for the state by Dr. Kirtland, who gave it the name *Cichla storeria*. "It occurs in large numbers in the Ohio river and its tributaries, rarely taken in Lake Erie," Jordan's Report; Muskingum river, Ohio river at Raccoon Island, Henshall, 1889; Lorain County, common, McCormick, 1892;

Franklin County, Scioto river, Olentangy river, Big Walnut creek, Big Darby creek, abundant, Williamson and Osburn, 1897; Ohio river at Ironton, Huron river at Milan, Wabash river at Celina, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, Chippewa lake, R. C. Osburn, 1900. It is worthy of note that in Chippewa lake, which drains into the Ohio river system, this species was found exceedingly abundant, but none of the next species, *P. sparoides*, were taken, while in Summit lake, with very similar surroundings, but draining into Lake Erie, only *P. sparoides* was taken. These lakes are but a short distance apart, the former being near Medina, the latter at Akron.

Pomoxis sparoides (Lacepede). CALICO BASS; GRASS BASS;
LAKE ERIE BASS; CRAPPIE; BACHELOR.

Head 3; depth 2. D. VII or VIII, 15; A. VI, 17 or 18; scales 7-44-12. Body less elongate than in *P. annularis*; the profile less sinuate, the region over the eye not being so much depressed. Fins very high, anal higher than dorsal, its height 4 or 5 times in length of body. Color silvery olive, mottled with olive green or dark, the markings not tending to vertical bars, but to small, irregular groups and covering the whole body. Anal fin heavily marked like the other vertical fins, with dark olive markings; a dusky opercular spot. Length 12 inches.

Not so common as the preceding, but widely distributed, and occurring throughout the state; perhaps not ascending streams as far as *P. annularis*. It is said to be more common than *P. annularis* in the lake drainage, while in the Ohio Valley, *P. annularis* is the more common. "In the Great Lakes in large numbers. I have seen but few from the Ohio Valley," Jordan's Report; Hamilton County, "common in Ross lake near Elmwood," Henshall, 1888; Lorain County, Lake Erie and lower parts of Beaver creek and Black river, McCormick, 1892; Maumee river at Defiance and Grand Rapids; St. Joseph river at Edgerton, Fish creek at Edgerton, St. Mary's river at St. Mary's and Rockford, Tiffin river at Brunersburg and West Unity, Hoaglin creek near Oakland, Kirsch, 1893; Franklin County, Scioto and Olentangy rivers, not common, Williamson and Osburn, 1897; Ohio river at Ironton, Wabash river at Celina, R. C. Osburn, 1899; Summit lake, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: AMBLOPLITES.

Ambloplites rupestris (Rafinesque). ROCK BASS; GOGGLE-EYE;
RED-EYE.

Head $2\frac{3}{4}$; depth 2 to $2\frac{1}{2}$; eye very large, $3\frac{1}{2}$. D. XI, 10 or 11; A. VI, 10; scales 5 to 7-40-12. Body oblong, compressed. Head large, profile little depressed above eye; mouth large and oblique, lower jaw projecting. Preopercle serrate near its angle. Color olive green, tinged more or less with brassy yellow, with much dark mottling; each scale with a dark spot producing longitudinal rows; a black opercular spot. Soft dorsal, anal and caudal with dark mottlings. Length 12 inches.

A widely distributed and abundant species found in all larger streams and lakes. Recorded by Kirtland as common. Abundant, Jordan's Report; "Lake Erie, Ohio river, near Little Sandy river," Henshall, 1889; Lorain County, "common in the larger streams, sometimes taken by the pound nets in the lake," McCormick, 1892; "A common fish at nearly all points where investigations were made," Maumee river basin, Kirsch, 1893; Franklin County, nearly every stream, common, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, not common, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Pippin lake, Cuyahoga river and Breakneck creek at Kent, R. C. Osburn, 1900.

Genus: CHÆNOBRYTTUS.

Chænobryttus gulosus (Cuvier and Valenciennes). WARMOUTH.

Head $2\frac{1}{3}$ to $2\frac{2}{3}$; depth 2 to $2\frac{1}{2}$; eye 4 to $4\frac{1}{2}$. The general form and dentition of *Ambloplites*, with the convex opercle, 10 dorsal and 3 anal spines of *Lepomis*. Preopercle entire. Head large, snout about equal to eye; mouth large, maxillary reaching posterior border of eye, teeth on vomer, palatines, pterygoids and tongue. D. X, 9 or 10; A. III, 8 or 9; dorsal spines low. Color dark olive green, clouded with darker, usually with red or blue, and brassy; a dark spot on each scale; belly yellowish or brassy. Length 8 to 10 inches.

Taken by Kirsch in the Maumee basin in Fish creek, at Edgerton, and Tiffin river at Brunersburg, "not common," 1893. Not recorded for the state by any other collector.

Genus: APOMOTIS.**Apomotis cyanellus** (Rafinesque). GREEN SUNFISH;
CREEK SUNFISH; LITTLE RED-EYE.

Head 3; depth $2\frac{1}{2}$. D. X, 11; A. III, 9; scales about 7-48-17, 8 rows on cheek. Body oblong, rather elongate in young, becoming short and deep in adults. Mouth large, larger than in *Lepomis* or *Eupomotis*, maxillary reaching nearly to middle of eye, lower jaw projecting. Gill rakers long and stiff. Lower pharyngeal teeth acute; a patch of teeth on basibranchial between second and third hypobranchials. Color generally greenish, sometimes nearly black; vertical fins marked with blue or green, in adults in spring the lower fins are very dark and all the fins are edged with silvery; dorsal and anal generally with a black spot on the posterior rays. Quite variable. Length 7 inches.

The Green Sunfish is an abundant resident of the streams of Ohio, but is rarely found in the lakes. It ascends the streams farther than any other species of this family, being found even in small brooks and spring runs. Hamilton County, "abundant in Ross lake and Little Miami river," Henshall, 1888; Lorain County, "abundant in the upper part of small streams and in small ponds," McCormick, 1892; Maumee river basin, "taken at nearly every point in all the streams that were examined," Kirsch, 1893; Franklin County, abundant in nearly every stream, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, not common, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Breakneck creek near Kent, outlet of Licking reservoir, R. C. Osburn, 1900.

Genus : LEPOMIS.*Key to Species.*

- A. Pectoral fins short, obtuse, not reaching beyond front of anal, considerably shorter than head.— *megalotis*.
- AA. Pectoral fins more or less pointed, not much if any shorter than head, and reaching to or beyond front of anal.
 - B. Opercular flap margined with red, sides with many red spots.— *humilis*.
 - BB. Opercular flap without red margin or spot; no red spots on sides, a large spot on posterior rays of dorsal and anal fins at base.— *pallidus*.

Lepomis megalotis (Rafinesque). LONG-EARED SUNFISH.

Head (without earflap) 3 in length; depth $1\frac{2}{3}$ to $2\frac{1}{2}$; eye $3\frac{1}{2}$ to 4. D. X, 10 to 12; A. III, 8 to 10; scales about 6–38–12, about 5 rows on cheek. Body short and deep, compressed; the back very strongly arched in adult, the profile very steep. Mouth small, oblique. Gill rakers very short and soft. Dorsal spines very low, 3 in head. Pectoral $1\frac{1}{3}$ to $1\frac{1}{2}$ in head. Opercular flap in adult very broad and long, with a pale blue or red margin which may be very broad or almost wanting; the flap much smaller in young. Color brilliant blue and orange; above chiefly blue, the belly entirely orange, lips blue; cheeks orange, with bright blue stripes; soft parts of vertical fins with the rays blue and membranes orange. An extremely variable species. Length 8 inches.

An abundant species in the Ohio river system, but not so common in the lake drainage. It occurs both in lakes and streams, but to greater extent in the latter. It does not ascend streams as far as *Apomotis cyanellus*, however. Given by Kirtland as *Pomotis nitida*. Hamilton County, "abundant in Ross lake," Henshall, 1888; Lorain County, rare, two specimens from Black river, 1890, McCormick; Maumee system, "all the larger streams and nearly all the smaller ones," July 17 given as a breeding date, Kirsch, 1893; Franklin County, nearly all the streams, apparently the most common sunfish, June 18 given as a breeding date, Williamson and Osburn, 1897; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Sandusky Bay, Summit lake, Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Lepomis humilis (Girard). RED-SPOTTED SUNFISH.

Head $2\frac{3}{4}$ to 3; depth $2\frac{1}{4}$ to $2\frac{1}{2}$; eye large, 3 to $3\frac{1}{2}$. D. X, 10 or 11; A. III, 8 or 9; scales large, 5-34-11, about 5 rows on cheek. Body oblong, profile not very steep. Mucous pores on head very large; opercular flap long, broad and with a very broad, red margin, which entirely surrounds the black. Longest dorsal spine not quite half head, pectoral a little shorter than head. Gill rakers rather long and blunt, well developed. Color, bluish with conspicuous greenish spots posteriorly; sides with many conspicuous round, salmon-red spots; a faint black spot on last rays of dorsal; belly and lower fins red. Length 4 inches.

This small, highly colored sunfish is found in Ohio in the southwestern part only. I know of but one record, as follows: Hamilton Co., "common in Ross lake and Clough creek," Henshall, 1888.

Lepomis pallidus (Mitchill). BLUE-GILL; BLUE BREAM;
COPPER-NOSED BREAM; BLUE SUNFISH.

Head $2\frac{3}{4}$ to $3\frac{1}{4}$; depth about 2; eye $3\frac{1}{2}$ to 4. D. X, 11; A. III, 10 to 12; scales about 7-45-12, 5 rows on cheek. Body comparatively short and deep, compressed; the young slender, adults nearly orbicular, caudal peduncle rather slender. Head rather small, the projecting snout forming an angle above eye. Mouth quite small, the maxillary barely reaching front of eye. Opercular flap very short in young, somewhat larger in adult, without pale edge. Gill rakers of moderate length, rather stiff. Dorsal fin high; pectoral fin long and narrow, longer than head, reaching past front of anal. Color, olive green, sometimes quite dark, sometimes with a silvery or golden luster. Adults in spring with the belly coppery red. Young, silvery with more or less distinct, chain-like bars of darker on the sides. No blue stripes on cheek; a black blotch at base of posterior rays of dorsal and anal. Extremely variable. Length 12 inches.

The Blue-gill is a very abundant species in the lakes of Ohio. It is quite common and widely distributed in the larger streams, but does not ascend small streams. Hamilton County, "abundant in Little Miami river and Ross lake," Henshall, 1888; Lorain County, "not common," McCormick, 1892; Maumee river system, "taken in all the streams and at nearly every point examined," Kirsch, 1893; Franklin County, Scioto and Olentangy rivers, Big Walnut and Big Darby Creeks, rare, June 14 given as a breeding date, Williamson and Osburn, 1897; Huron river at

(*Lepomis machrochirus* Rafinesque, has been taken in the head waters of the Ohio in western Pennsylvania, by Cope, and in the Ohio river, by Rafinesque and Jordan, but as I know of no record of its capture within the state, I hesitate to include it in the list, though it doubtless occurs rarely in the Ohio.)

Milan, Sandusky Bay, Wabash river at Celina, R. C. Osburn, 1899; I have observed the species also at Licking and St. Mary's reservoirs. In both of these and in Sandusky Bay it is very abundant; Pippin lake, Chippewa lake, Summit lake, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: EUPOMOTIS.

Key to Species.

- | | | |
|-----|--|------------------|
| A. | Cheeks without marked blue or orange spots or lines. | |
| B. | Scales large, 34 to 39 in lateral line.— | <i>heros.</i> |
| BB. | Scales moderate, 33 in lateral line. | <i>euryorus.</i> |
| AA. | Cheeks with wavy blue lines, scales about 45; lower posterior border of opercular flap always scarlet. | <i>gibbosus.</i> |

Eupomotis heros (Baird and Girard).

Head $2\frac{1}{4}$ to 3; depth 2 to $2\frac{2}{3}$; eye $3\frac{1}{2}$ to $4\frac{1}{3}$; snout $3\frac{1}{2}$ to 4. D. X, 11; A. III, 11; scales 4-34 to 39-13, 4 rows on cheek. Appearance of *Lepomis pallidus*. Body robust, moderately elongate, dorsal and ventral outlines about equally curved. Head rather large, a considerable depression in profile above eye; mouth rather large, maxillary reaching past front of eye. Dorsal spines rather high; pectorals reaching beyond middle of anal. Opercular flap smaller than eye, much as in *E. gibbosus*. Pharyngeal teeth not so blunt as in *gibbosus*. Color dark greenish above, gradually becoming brassy on belly; opercular spot greenish black, the flap with a broad, blood-red border in male, plain in females. No spot on dorsal or anal. Length about 8 inches.

This is a species of southern distribution, and in Ohio probably occurs only in the southwestern part of the state. It has been recorded, in 1888, for the Little Miami river in Hamilton County, by Henshall, under the name *Lepomis notatus*.

Eupomotis euryorus (McKay).

Head $3\frac{3}{4}$; depth $2\frac{2}{3}$. D. X, 11; A. III, 10; scales 6-43-14, 6 or 7 rows on cheek. Body very robust, compressed, dorsal outline more convex than ventral; profile steep, convex. Mouth oblique, small, maxillary reaching front of eye. Teeth on front of palatines. Lower pharyngeals with the rather long posterior spur turned up, stoutish; the inner angle rounded, somewhat obtuse. Teeth stout, very much blunted, not close set. Gill rakers short and stout, the inner surface roughened. Opercular flap nearly as long as snout, with a very broad, pale membranous margin. Dorsal spines low; ventrals and pectorals short, reaching vent. Color in spirits, mottled olive, yellowish below; top of head blackish; membranes of vertical fins dusky; ventrals dusky, with lighter margins; pectorals pale. Length 8 inches.

This rare sunfish has been recorded from but two localities in Ohio, both of these to the credit of Mr. McCormick, who says of them: "I took several specimens near Huron, July 6, 1891, and two near Lorain, in September." Only two other specimens were known at the time Mr. McCormick took these.

***Eupomotis gibbosus* (Linnaeus). COMMON SUNFISH ;
PUMPKIN SEED ; SUNNY.**

Head 3 to $3\frac{1}{4}$; depth $1\frac{3}{4}$ to 2; eye 4 to $4\frac{1}{2}$; snout $4\frac{1}{2}$. D. X, 10 to 12; A. III, 10 or 11; scales about 6-44-13, 4 rows on cheek. Body short and deep, compressed, the profile steep, convex. Head rather small; mouth small, maxillary scarcely reaching front of eye. Dorsal spines high, the longest 2 to $2\frac{1}{2}$ in head, equal to distance from snout to posterior edge of pupil; pectorals long, as long as head. Gill rakers short and soft, weaker than in any other species except *Lepomis megalotis*. Pharyngeal teeth all bluntly rounded, paved, the bones very broad and somewhat concave. Opercular flap small, the lower posterior part always bright scarlet, a character which distinguishes this species at once in the adult. Color greenish olive, brilliantly marked with blue and orange on the sides; belly orange; lower fins orange, upper blue and orange-spotted; cheeks orange, with wavy blue streaks. One of the most gaudy of our Sunfishes, and quite variable. Length 8 inches.

An abundant species in the ponds and lakes of central and northern Ohio, common in the large streams and in the quiet waters of bayous. Not common in the smaller streams, and said to be rather rare in the southern part of the state. In Sandusky Bay and in Licking reservoir it is the most abundant sunfish. Ross lake, Hamilton County, and Lake Erie, Henshall, 1889; Lorain County, "very abundant below the ripples in the larger streams, and in the bayous near the lake. A few taken in the pounds," Camden lake, McCormick, 1892; Maumee river system, "abundant in all the lakes, common in all the larger streams, except the Auglaize river, less common in the smaller streams," Kirsch, 1893; Franklin County, Scioto and Olentangy rivers, Big Walnut and Big Darby creeks, not common, Williamson and Osburn, 1897; Huron river at Milan, Sandusky Bay, St. Mary's reservoir, Wabash river at Celina, North Fork of Licking river at Newark, R. C. Osburn, 1899; Pippin lake, Chippewa lake, Summit lake, Licking reservoir, abundant in all these localities, R. C. Osburn, 1900.

Genus: MICROPTERUS.

Key to Species.

- A. Eleven rows of scales above lateral line, about 17 rows on cheek.— *dolomieu*.
 AA. Seven rows of scales above lateral line, about 10 rows on cheek.— *salmoides*.

Micropterus dolomieu Lacepede. SMALL-MOUTHED BLACK BASS.

Head $2\frac{1}{2}$ to $3\frac{1}{2}$; depth $2\frac{3}{4}$ to $3\frac{1}{2}$; eye 5 to $6\frac{1}{2}$. D. X, 13 to 15; A. III, 10 to 12; scales 11-72 to 85-25 (Ohio specimens average about 75 in lateral line). Body rather elongate in young, becoming deeper with age. Mouth large, but smaller than in *M. salmoides*, the maxillary usually not extending back of posterior edge of orbit. This species can always be distinguished at once from *M. salmoides* by the smaller scales, there being 11 rows of scales above the lateral line, while in *salmoides* there are but 7 rows. The color is exceedingly variable, giving rise to a number of local names among sportsmen. The usual color is a dark green, with bronze or golden reflections, sometimes almost black on the back; belly lighter. A lateral band never present. Said to reach a length of 2 feet.

Widely distributed over the state and common everywhere in suitable localities. Dr. Jordan aptly says in regard to its habits, "as compared with *M. salmoides* it is a fish of the running waters, having little liking for warm and grassy ponds, bayous or lakes." It is found in nearly all streams, sometimes even ascending small, spring-fed brooks. Recorded by all students of Ohio fishes from Rafinesque and Le Sueur on down, and under a great variety of names. I give the locality records of later investigators. Hamilton County, "common in Little Miami river," Henshall, 1888; Lorain County, "common in the larger streams, not so often seen in the lake as the next species," McCormick, 1892; Maumee river system, "common in all the streams, none from the lakes," Kirsch, 1893; Franklin County, generally abundant, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, nearly all streams, abundant in some places, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Ice creek at Iron-ton, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Micropterus salmoides (Lacepede). LARGE-MOUTHED BLACK BASS ;
OSWEGO BASS ; GREEN BASS ; BAYOU BASS.

Head 3 to $3\frac{1}{2}$; depth 3 to $3\frac{1}{4}$; eye 5 to 6. D. X, 12 or 13; A. III, 10 or 11; scales 7-65 to 70-18. Body much as in *M. dolomieu*, ovate-fusiform. Mouth very large, maxillary (except in very young) reaching past eye. Always distinguishable from *M. dolomieu* by the larger scales, 7 rows above lateral line. Color variable, usually dark green above, becoming greenish silvery on sides and belly. Young always with a distinct, black lateral band, which becomes fainter with age and disappears entirely at about the fourth year. Length $1\frac{1}{2}$ to $2\frac{1}{2}$ feet.

This species is found in lakes, bayous and in channels of larger streams. It is a fish of the quiet water. Widely distributed. Like the preceding species it has been the subject of much synonymy. Rafinesque records it under the name *Lepomis pallida*, for the Ohio, Miami and Hocking rivers. Hamilton County, "common in Ross lake," Henshall, 1888; Lorain County, "more common in the lake than in the streams," McCormick, 1892; Maumee river system, common in all the lakes, also common in the Maumee river and most of its larger tributaries, but none in Auglaize river or its tributaries, Kirsch, 1893; Franklin County, Scioto river, Big Walnut creek, Big Darby creek, not common, Williamson and Osburn, 1897; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Wabash river at Celina, R. C. Osburn, 1899; Pippin lake, Chippewa lake, Summit lake, Grand river at Painesville, Licking reservoir, R. C. Osburn, 1900.

*Family : PERCIDÆ.**Key to Genera.*

- A. *Pseudobranchiæ* well developed; preopercle serrate; branchiostegals 7; no anal papilla.
- B. Canine teeth on jaws and palatines; body elongate; ventral fins well separated.— STIZOSTEDION.
- BB. Canine teeth none; body oblong, ventral fins near together.— PERCA.
- AA. *Pseudobranchiæ* imperfect or wanting; preopercle entire or nearly so; branchiostegals 6; anal papilla usually present.
- C. Parietal region of skull depressed, not strongly convex in transverse section, $\cap$ -shaped in section.
- D. Cranium broad between the eyes, snout conic, projecting pig-like beyond the inferior mouth.— PERCINA.
- DD. Cranium not broad between the eyes, snout not much projecting.
- E. Body not hyaline nor extremely elongate, its surface almost entirely covered with scales.
- F. Premaxillaries not protractile, the skin of the premaxillary continuous in the middle with that of the forehead with no cross groove between.— HADROPTERUS.
- FF. Premaxillaries protractile (in *Collogaster shumardi* a narrow, connecting frenum sometimes crosses from the premaxillary to the forehead).
- G. Anal spines 2, both well developed, the first usually the longer.
- H. Mid-line of belly naked or covered by caducous shields; gill membranes scarcely connected.— COTTOGASTER.
- HH. Belly covered with ordinary scales; gill membranes broadly connected.— DIPLESION.
- GG. Anal spine single, obscure; anal fin small, much shorter than soft dorsal.— BOLEOSOMA.
- EE. Body extremely elongate, hyaline, subterete, the belly mostly naked.
- I. Premaxillaries not protractile; dorsal spines 12 or 13.— CRYSTALLARIA.
- II. Premaxillaries protractile; dorsal spines 9 to 11.— AMMOCRYPTA.
- CC. Parietal region of skull not depressed, more or less strongly convex in cross-section, $\cap$ -shaped; premaxillaries never protractile; belly covered with ordinary scales.
- J. Lateral line straight; body rather robust.— ETHEOSTOMA.
- JJ. Lateral line with a slight arch running high anteriorly; body slender.— BOLEICHTHYS.

Genus: STIZOSTEDION.

Key to Species.

- A. Pyloric coeca 3; soft dorsal with about 20 rays; a black spot on last dorsal spines.—
vitreum.
- AA. Pyloric coeca 4 to 7; soft dorsal with about 17 rays; no black spot on posterior dorsal spines, a black blotch at base of pectoral: second dorsal with rows of dark spots.—
canadense.

Stizostedion vitreum (Mitchill). WALL-EYED PIKE; PIKE PERCH;
YELLOW PIKE; BLUE PIKE; JACK SALMON.

Head $3\frac{2}{3}$; depth about $4\frac{1}{2}$; eye $4\frac{1}{2}$ to 5. D. XII to XVI, 19 to 21; A. II, 12 to 14; scales 10-110 to 132-25; lateral line incomplete. Body slender, becoming compressed with age. Cheeks and upper surface of head nearly naked. Dorsal spines high, more than one-half the length of head; dorsal fins well separated; soft dorsal nearly as long as the spinous. Pyloric coeca, 3. Color, dark olive, finely mottled with brassy; sides of head more or less vermiculated; belly and lower fins pinkish; spinous dorsal with a large, jet black spot on posterior 2 or 3 membranes. Length about 3 feet.

Common in Ohio river and Lake Erie, and sometimes ascending their larger tributaries. Kirtland reported it from Lake Erie and the Maumee and Ohio rivers under the name *Lucio-perca americana*. Hamilton County, "abundant in the Ohio river," Henshall, 1888; Lorain County, "very common in the lake, entering the streams occasionally," McCormick, 1892; Maumee river at Grand Rapids and Toledo, and Lake Erie around the mouth of the Maumee in large numbers, Kirsch, 1893; Huron river at Milan, Sandusky Bay, R. C. Osburn, 1899.

Stizostedion canadense griseum (De Kay). SAUGER; SAND PIKE;
GRAY PIKE; PICKERING.

Head $3\frac{1}{2}$; depth varying with age, $4\frac{1}{2}$ to 6; eye 5. D. XI to XV-I, 17 to 19; A. II, 11 or 12; scales 9-100 to 125-27; lateral line incomplete. Body more terete than in *S. vitreum*. Head depressed, pointed; opercular spines fewer than in the typical *S. canadense*, and the head less completely scaled. Color, olive gray, sides brassy or orange, with dark mottlings; spinous dorsal with 2 or 3 rows of irregular, dark spots, no large, black spot on posterior rays. A more translucent fish than *S. vitreum*. Pyloric coeca 4 to 7. Length about 18 inches.

Distributed about as the preceding species. Common both in the lake and Ohio river. "Abundant in the Great Lakes, plentiful in Ohio river," Jordan's Report; Hamilton County, "common in the Ohio river," Henshall, 1888; Lorain County, "common in the lake, entering streams oftener than *S. vitreum*,"

McCormick, 1892; Maumee river at Grand Rapids, Waterville and Toledo, Blanchard river at Ottawa, west end of Lake Erie, Kirsch, 1893. I have seen many dead ones on the lake beach at Sandusky.

Genus: PERCA.

Perca flavescens (Mitchill). YELLOW PERCH; RINGED PERCH.

Head $3\frac{1}{4}$; depth $3\frac{1}{4}$. D. XIII to XV-II, 13 to 15; A. II, 7 or 8; scales 7-74 to 88-17; lateral line incomplete. Body slender in young, becoming stouter with age; adults have the back considerably arched, the profile convex from dorsal to occiput, thence concave forward to the projecting snout. Cheeks closely scaled; well developed striae on operculars and rugosities on top of head. Color, dark olivaceous above, sides golden yellow, with 6 or 8 broad, dark vertical bars; belly pale, lower fins red or orange. Length 1 foot.

A fish of the quiet waters, found abundant in the reservoirs, ponds, bayous and lakes of central and northern Ohio, but not recorded for the southern part of the state. Kirtland recorded it (*Bodianus flavescens*) as abundant in Lake Erie and the small lakes of northern Ohio. "St. Mary's reservoir and Lake Erie," Henshall, 1889; Lorain County, "common in the lake and lower portions of the rivers," McCormick, 1892; Maumee river at Grand Rapids, Waterville and Toledo, St. Mary's river at St. Marys, Tiffin river at Brunersburg, west end of Lake Erie, Kirsch, 1893; Huron river at Milan, Sandusky Bay, Wabash river at Celina, St. Mary's reservoir, R. C. Osburn, 1899; Summit lake and Licking reservoir, R. C. Osburn, 1900. It is very abundant in Sandusky Bay and common in Licking reservoir. I have also seen the species from the Ohio canal at Newark.

Genus: PERCINA.

Percina caprodes (Rafinesque). LOG PERCH; HOGFISH;
HOG MOLLY; STONE ROLLER.

Head 4 to $4\frac{3}{4}$; depth 5 to $6\frac{1}{2}$; eye 4. D. about XV-15; A. II, 11. Body elongate, slender. Head long and pointed, depressed and sloping above; snout "pig-like," projecting beyond the inferior mouth; eyes widely separated. Color, light yellowish or yellowish green, with about 15 vertical, dark bars extending down on sides below lateral line and alternate with the same number of shorter bars. Length 8 inches.

This largest of Ohio darters is widely distributed over the state and generally common. It is found in the quiet waters of streams of all sizes (but more commonly in the larger ones), and in lakes, on gravelly or sandy bottom. Given by Rafinesque for the Ohio and Miami. Kirtland reported it "common," and Jordan, "generally abundant." Hamilton County, "common in Little Miami river and Ross lake," Henshall, 1888; Lorain County, "not very common, taken both in rivers and the lake, abundant in Sandusky Bay and Put-in-Bay, and it formed the bulk of the fishes that I saw among the terns' nests on Rattle Snake Island," McCormick, 1892; Maumee river system, rather common, nearly all streams, Kirsch, 1893; Franklin County, generally distributed, common, but nowhere abundant, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, "common," Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Lake Erie at Sandusky, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Chippewa lake, Summit lake, Grand river at Painesville, Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

To the northward this species is represented by the following variety :

***Percina caprodes zebra* (Agassiz). MANITOU DARTER.**

This variety is found in the northern part of the state, with the typical *caprodes*. It is known chiefly by the lack of scales on the nuchal region, the rather more slender form, and the shorter vertical bars. It intergrades with the typical *caprodes*.

The Manitou Darter has been recorded for the state by McCormick in Lorain County, 1892, as "occurring with the typical form in proportion of about 1 to 3, some specimens showing intermediate stages;" Lake Erie at Sandusky, Cuyahoga river at Hawkins, and Grand river at Painesville, R. C. Osburn, 1900.

Genus: HADROPTERUS.*Key to Species.*

- A. Mid-line of belly with a series of enlarged caducous plates, which fall off at certain intervals, leaving a naked strip from breast to vent; preopercle strictly entire, not serrated.
- B. Lower jaw as long as upper, snout very narrow and pointed.—*phoxocephalus*.
- BB. Lower jaw shorter than upper, included; head moderate, not long and pointed.
 - C. Cheeks with very small scales; dorsal spines 13 to 15.—*aspro*.
 - CC. Cheeks naked; dorsal spines 10 to 12.—*evides*.
- AA. Enlarged plates of mid-line of belly persistent at least posteriorly; preopercle finely serrated.—*scierus*.

Hadropterus phoxocephalus (Nelson).

Head $3\frac{2}{3}$ to 4; depth $5\frac{1}{2}$ to 6; eye $4\frac{1}{2}$. D. XI or XII-12 to 14; A. II, 8 or 9; scales 12-80 to 85-16; lateral line incomplete. Body slender. Head very long and pointed; mouth terminal, large; jaws sub-equal; snout very long, acuminate. Cheeks, opercles and neck with small scales, breast naked; caducous shields of midline of belly small. Gill membranes somewhat connected. Color, brownish olive, much vermiculated; a row of about 14 dark, quadrate spots, sometimes confluent, along lateral line. Length 6 inches.

Recorded from three widely separated localities, which would indicate a general distribution, yet it seems to be quite rare except in the southwestern part of the state, where Henshall, 1888, reports it as common in Little Miami river. One specimen was taken near Lorain, by McCormick, 1892; and Mr. E. B. Williamson and the writer took a single specimen in Big Walnut creek near Lockbourne, Franklin County.

Hadropterus aspro (Cope and Jordan). BLACK-SIDED DARTER.

Head 4; depth 5 to 6; eye 4. D. XIII to XV-II to 13; A. II, 8 to 10; scales 9-65 to 80-17, lateral line incomplete. Body rather elongate, subterete, compressed behind. Head moderately elongate; snout blunt; mouth sub-inferior, lower jaw included; gill membranes slightly or not at all connected. Opercle with rather large scales; cheek with very small, imbedded scales; breast naked; caducous scales of mid-ventral line rather large. Color light yellowish or greenish yellow, tessellated above with dark olive or blackish; white below; about 8 large, dark blotches along lateral line, these often confluent; fins barred. Length about 4 inches.

A common species throughout the state. Found in clear streams on gravelly bottom. Hamilton County, "common in East Mill creek," Henshall, 1888; Lorain County, "nowhere common, but found in most streams and the lake," McCormick, 1892; Maumee river system, "abundantly distributed in all the

streams examined," Kirsch, 1893; Franklin County, a common darter of general distribution, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, "common," Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, outlet of Licking reservoir, R. C. Osburn, 1900.

***Hadropterus evides* (Jordan and Copeland).**

Head $4\frac{1}{3}$; depth $5\frac{1}{3}$; eye $3\frac{1}{2}$, large and high in head. D. XI-10; A. II, 8 or 9; scales 9-52 to 67-9 to 11. Body moderate, somewhat compressed. Head heavy, the profile rather convex. Mouth moderate, lower jaw included. Cheeks, nape and throat naked; opercles with rather large caducous scales; ventral shields but little enlarged. Fins large, pectorals long. Coloration extremely brilliant in breeding males, females and young plainer. General color above, dark olivaceous, tessellated with darker; back and sides with about 7 broad, transverse bars; fins marked with orange, black, bronze, yellow and blue-black. "One of the most brilliant of all fishes." Length 2 or 3 inches.

Rare in Ohio, its distribution being more westerly. The species has, however, been taken in the Ohio river at Raccoon Island, by Dr. Henshall, 1889, and by Kirsch, in the Maumee river at Grand Rapids.

***Hadropterus scierus* Swain.**

Head 4 to $4\frac{1}{2}$; depth 5 to 6; eye 4 to $4\frac{1}{2}$. D. XIII-13 or 14; A. II, 9; scales 7-68 to 70-17. Body robust. Head rather short, snout bluntish; mouth small, lower jaw included; preopercle more or less distinctly serrate. Gill membranes broadly connected. Opercle with large scales, those on cheek slightly smaller. Throat naked, breast nearly so. Ventral shields but little enlarged and not caducous except anteriorly. Color yellowish olive, everywhere vaguely blotched with black; top of head, dorsal, anal and ventral fins black in male, paler in female; scales everywhere finely punctulate with brown; sides with a few larger, black specks. Length 5 inches.

Rare. Like the preceding species, its distribution is westerly. I know of but one record for the state, that by Henshall, "Ohio river, near Little Sandy river, 1889."

***HADROPTERUS PELTATUS* (Stauffer).**

Mr. McCormick has recorded (1892) this species from Vermillion river, two specimens. *H. peltatus*, as now understood, occurs from southeastern Pennsylvania southward along the coast, and is not known west of the Alleghanies, so I am inclined to think there must be some error in the above record. Under this belief I omit the species from the Ohio list.

*Genus: COTTOGASTER.**Key to Species.*

- A. Mid-line of belly with a series of enlarged caducous scales or plates.— *copelandi*.
 AA. Mid-line of belly naked anteriorly, covered with ordinary scales posteriorly.— *shumardi*.

Cottogaster copelandi (Jordan).

Head $3\frac{3}{4}$ to $4\frac{1}{4}$; depth $5\frac{1}{2}$ to $6\frac{1}{2}$; eye about $3\frac{1}{2}$. D. X to XII—10 to 12; A. II, 8 or 9; scales 6-44 to 56-8. Body rather slender. Head rather large and long, much resembling that of *Boleosoma*. Mouth small, horizontal, sub-inferior, cheeks naked; opercles and neck with a few scales, throat naked; ventral plates well developed. Pectoral fin as long as head. Color, brownish olive, tessellated above; a series of small, oblong, dark blotches along lateral line, sometimes indistinct. Vertical fins with dusky specks; a black spot on anterior rays of spinous dorsal. Length $2\frac{1}{2}$ or 3 inches.

Widely distributed over the state, but apparently very rare everywhere. Muskingum river, and Ohio river at Raccoon Island, 1889, and Lake Erie at Put-in-Bay, Henshall; Lorain County, "Vermillion river, but one specimen taken," McCormick, 1892; Maumee river at Toledo, two specimens, Kirsch, 1893; in Huron river at Milan, in 1897, two specimens were taken by Prof. D. S. Kellicott, Mr. E. B. Williamson and the writer.

Cottogaster shumardi (Girard).

Head $3\frac{2}{3}$ to 4; depth 5 to $5\frac{1}{2}$; eye $3\frac{1}{2}$. D. IX to XI—13 to 15; A. II, 10 to 12; scales 6-48 to 60-11. Body stout, heavy forward, compressed behind. Head broad and thick. Mouth large and broad, lower jaw the shorter. Premaxillaries usually protractile, but a narrow frenum sometimes present. Cheeks, opercles and neck usually scaly; chest naked; belly naked anteriorly, scaled for a short distance before vent. Color dark, densely but vaguely spotted with darker; sides with 8 or 10 obscure blotches; a large, black spot at base of spinous dorsal behind, and a small one in front. Length 3 inches.

Not common, but occurring in both the Lake Erie and Ohio river drainage. Found on sandy bottom in rivers, not found in small streams. Recorded by Henshall for the Muskingum river and for the Ohio river near Parkersburg, 1889; recorded for Vermillion river as *Etheostoma wrighti*, by McCormick, 1892; in 1899 the writer took a half dozen specimens in the Ohio river at Ironton, and in August, 1900, the species was again taken at Bellaire.

*Genus: DIPLESION.***Diplesion blennioides** (Rafinesque). GREEN-SIDED DARTER.

Head about $4\frac{1}{2}$; depth $4\frac{3}{4}$ to 6. D. XII to XIV-12 to 15; A. II, 8 or 9; scales 6-58 to 78-14. Body elongate, subterete. Head short, profile very convex, snout very blunt, cheeks tumid; eyes large, $3\frac{1}{2}$, high up and close together; mouth small, inferior; gill membranes broadly connected. Cheeks with fine scales, opercles with large ones, breast naked. Color dark olive green, tessellated above; sides with 7 or 8 Y-shaped, dark bars, these sometimes confluent to form a dark zigzag band. In highly colored males a number of broad, bright green bands almost encircle the body. Females and young may be quite dull, but the pattern of the dark marks on the side is characteristic. Length 3 to 5 inches.

The Green-sided Darter is an abundant resident of the clear, rapid streams of the state, found especially on stony ripples. Rafinesque records it from the Ohio and Muskingum. Kirtland mentions its occurrence in the state, and Jordan gives it as "abundant." Hamilton County, "abundant in East Mill creek and Little Miami river," Henshall, 1888; "Vermillion river, scarce, not uncommon in Sandusky Bay," McCormick, 1892; Maumee river system, taken in all the large streams (except St. Mary's river) and nearly all the smaller ones, Kirsch, 1893; Franklin County, abundant, and of general distribution, Williamson and Osburn, 1897; Big Jelloway creek system, common on ripples, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Breakneck creek at Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Bellaire, R. C. Osburn, 1900.

*Genus: BOLEOSOMA.***Boleosoma nigrum** (Rafinesque). JOHNNY DARTER.

Head about 4; depth 5 to 6; eye $3\frac{1}{2}$ to 4. D. IX-II to 14; A. I, 7 to 9; scales 5-44 to 55-9. Body fusiform, slender. Head moderate, snout somewhat bluntly decurved; mouth small, lower jaw included. Cheeks and breast usually naked; opercles scaly. Anal spine short and weak; fins all high.

Color usually pale olivaceous, much tessellated above; sides with numerous small W-shaped, dark blotches. Males in breeding season heavily pigmented, especially anteriorly, with blue-black. A black line forward and downward from eye. Fins barred. Length 2 to 2½ inches.

The little Johnny Darter is found all over Ohio, and is usually quite abundant. It inhabits lakes and rivers on sandy bottom, the clear creeks of Ohio are favorite abiding places, and every small brook and spring run large enough to contain any fish at all will be found to have its quota of "Johnnies." Hamilton County, "common in Little Miami river," Henshall, 1888; Lorain County, "very common everywhere, one of the few species that may be depended upon when the seine is drawn," McCormick, 1892; Maumee river system, common everywhere, Kirsch, 1893; Franklin County, taken in every stream, abundant, April 3rd given as a breeding date, Williamson and Osburn, 1897; Big Jelloway creek system, abundant in every stream, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Pippin lake, Chipewewa lake, Summit lake, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: CRYSTALLARIA.

Crystallaria asprella (Jordan).

Head $4\frac{1}{5}$ to $4\frac{1}{2}$; depth 7 to 8. D. XII to XIV-13 to 15; A. I, 12 to 14; scales 7 to 10-98 to 100-10. Body long and slender. Head long and slender; eye large; mouth not large, subterminal; premaxillaries not protractile; opercular spine well developed. Cheeks and opercles with pectinate scales; throat and belly naked, space between ventrals scaled. Color translucent olive, pellucid in life; with 3 or 4 more or less distinct, dark cross bands on back and sides; a dark lateral band made up of about 10 more or less confluent blotches. Length 5 or 6 inches.

Apparently a very rare species in Ohio, and confined to larger streams. Recorded by Henshall for the Muskingum river, 1889 ; and one specimen was taken on sandy bottom in the Ohio river at Ironton, May 31, 1899, by the writer.

Genus: AMMOCRYPTA.

***Ammocrypta pellucida* (Baird). SAND DARTER.**

Head 4 to $4\frac{3}{4}$; depth 7 to $8\frac{1}{2}$. D. X-10; A. I, 8 to 10; scales in lateral line about 75, about 6 rows above lateral line. Body very long, terete, quite pellucid in life. Head stout; eyes large, high up, interorbital space narrow. Cheeks, opercles, and temporal region with embedded scales; belly and sides below lateral line entirely naked; much of dorsum in front and on either side of dorsal fin naked or thinly scaled. Translucent, sometimes tinged with olivaceous; scales with narrow, dark edging; about 12 or 15 black blotches along the sides; a gilt lateral band. Length 3 inches.

The Sand Darter is well distributed over the state and is common locally in larger streams on sandy bottoms. Taken also in the lake. Hamilton County, common in Little Miami river, Henshall, 1888 ; Lorain County, Lake Erie and the larger streams, not common, McCormick, 1892 ; "common everywhere on sandy bottom in the Maumee river, and in the lower courses of the larger tributaries," Kirsch, 1893 ; Franklin County, Olentangy river, Big Walnut and Little Walnut, Big Darby and Black Lick creeks, not common, June 28 given as a breeding date, Williamson and Osburn, 1897 ; Huron river at Milan, Wabash river at Celina, Stillwater creek near Dayton, R. C. Osburn, 1899 ; Grand river at Painesville, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: ETHEOSTOMA.

Key to Species.

- A. Lateral line complete. (A few tubes rarely wanting.)
 - B. Gill membranes broadly connected across the isthmus.
 - C. Anal fin nearly as large as soft dorsal; spinous dorsal with about 13 spines.— *variatum*.
 - CC. Anal fin much smaller than soft dorsal; spinous dorsal with 10 or 11 spines.— *zonale*.
 - BB. Gill membranes scarcely connected across the isthmus.
 - D. Head short, the muzzle abruptly decurved, mouth somewhat inferior, lower jaw included.— *camurum*.
 - DD. Head rather long and pointed, snout not decurved, mouth terminal, jaws subequal.— *maculatum*.
- AA. Lateral line more or less incomplete.
 - E. Humeral region without differentiated black, scale-like process.—*coeruleum*.
 - EE. Humeral region with distinct, black process or scale.
 - F. Gill membranes scarcely connected; lower jaw not projecting.— *tippecanoe*.
 - FF. Gill membranes connected; lower jaw strongly projecting.—*flabellare*.

Etheostoma variatum Kirtland.

Head $3\frac{1}{2}$ to 4 or more; depth $4\frac{1}{3}$ to $5\frac{1}{2}$; eye $3\frac{1}{2}$ to 4. D. XII-13 (XII to XIV-11 to 13); A. II, 7 to 10; scales 8-51 to 63-12. Body moderately elongate, not much compressed, the back somewhat arched. Head short and thick; snout short and blunt, decurved, parietal region broad and depressed, resembling *Hadropterus* in this respect; profile above eyes strongly decurved; mouth small, lips thick, lower jaw included; premaxillary not protractile; gill membranes united. Head naked except 1 to 3 scales on opercle above; breast loosely scaled. Fins all very large, pectorals reaching beyond tips of ventrals. General color above, dark greenish olive, becoming barred vertically on the sides posteriorly, about four black blotches across the back. Females and young similarly marked, but paler. The following color description taken from the living specimen is typical of breeding males: Color, dark olive, with about 8 greenish cross-bars on posterior part of body; interspaces pale, each with 2 bright carmine spots; back crossed by 4 black bars; sides of belly bright orange; middle of belly pale; first dorsal dark brown at base, then a pale space, above this a wide, dark bar, then another pale space, bordered with bright orange; second dorsal and caudal flecked with carmine; anal greenish, bordered with pale orange; ventrals greenish black with a little orange at the margin; pectorals tinged with orange and green, the rays with carmine spots. Length $3\frac{1}{2}$ inches.

This elegant darter was described by Dr. Kirtland from the Mahoning river in 1838, and was not taken again in the state for fifty years, until, in 1888, Henshall recorded it for the Little

Miami river, near Red Bank, as "not rare." In April, 1897, Mr. J. B. Parker found it common on swift ripples in Big Jelloway creek, Knox County, and in May, 1898, Messrs. Parker, Williamson and the writer, seining the Big Jelloway creek system, found this to be "the most abundant darter, especially frequenting swift ripples." In Franklin County, in the summer of 1897, the species was taken by Mr. E. B. Williamson and the writer on swift ripples in Big Walnut creek, Little Walnut creek, and Black Lick, but nowhere common. In 1899 the writer took the species in North Fork of Licking river near Newark; and in 1900, in the Ohio river at Bellaire.

***Etheostoma zonale* (Cope).**

Head 4 to 5; depth 4 to 6; eye $3\frac{1}{2}$ to 4. D. X or XI-10 to 12; A. II, 6 to 8; scales about 6-50-9. Body rather slender, somewhat compressed. Head small and short; mouth small, subinferior; snout blunt, profile rapidly descending; gill membranes broadly connected. Cheeks, opercles and neck usually scaled, breast usually naked. Color clear olive green above, with 8 or 10 greenish blue vertical bands which encircle the body posteriorly; below paler, with a brassy tinge; breast greenish black. First dorsal black at base, then a wide orange bar margined with black anteriorly, with greenish posteriorly; second dorsal orange at base, dark above; caudal and pectorals plain, tinged with green; anal and ventrals green, black at base. Young and females dull and speckled, the vertical bars indistinct and the fins speckled. Length 2 or 3 inches.

This species has been taken in a number of localities of the state, indicating a pretty general distribution. It is locally common, but is only taken on swift ripples. Hamilton County, "common in East Mill creek and Little Miami river," Henshall, 1888; Franklin County, Scioto river, Olentangy river, Big Walnut creek, Little Walnut creek, Alum creek, Black Lick, common where found, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, "common on swift ripples," Parker, Williamson and Osburn, 1898; Huron river at Milan, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900.

***Etheostoma camurum* (Cope). BLUE-BREASTED DARTER.**

Head $3\frac{1}{2}$ to 4; depth 4 to $4\frac{1}{2}$. D. XI-12 or 13; A. II, 8; scales 7-50 to 58-8. Body stout, rather compressed. Head short; snout blunt, profile

rapidly descending; lips thick, lower jaw included. Caudal peduncle deep. Color, dark olivaceous, sometimes nearly black above, somewhat barred on the sides; a dark longitudinal line on each row of scales; sides irregularly flecked with crimson dots; belly pale; throat and breast deep dark blue. Fins marked with brown, green, black, yellow and crimson. Females less distinctly marked. Length $2\frac{1}{2}$ inches.

The Blue-breasted Darter is rather rare in Ohio, although it has been taken at a number of widely separated localities, which would indicate a general distribution. It is found in company with *E. zonale*, on swift, stony ripples, but is much less frequent in occurrence. Jordan mentions it for the Mahoning river; "Muskingum river," Henshall, 1889; Franklin County, Scioto river, Olentangy river, Big Walnut creek, not common, Williamson and Osburn, 1898; Huron river at Milan, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899.

***Etheostoma maculatum* Kirtland.**

Head $3\frac{3}{4}$ to 4; depth $4\frac{2}{3}$ to $5\frac{1}{4}$. D. XII-12 or 13; A. II, 8 or 9; scales 9-56 to 63-14. Body elongate, caudal peduncle very deep. Head acuminate, the front descending very gradually, the mandible rising as gradually to its extremity; jaws subequal. Lateral line complete; cheeks naked; opercles scaled; gill membranes not connected. Color, above black, shading to dark olive below; throat turquoise blue; sides and dorsum marked with small, circular spots of bright crimson. First dorsal uncolored, with a black spot at its base in front and a dark shade through the middle; second dorsal blood red; caudal with two large, crimson spots confluent on the mid-line of the tail at its base. Female dull, the fins dark barred and not crimson. Length $2\frac{1}{2}$ inches-

Very rare. The species was described in 1838 from specimens taken in the Mahoning river by Dr. Kirtland. I know of but one subsequent record of its capture within the state. Mr. E. B. Williamson and the writer took a single specimen, a female with ripe eggs, from a swift ripple in Big Walnut creek, near Lockbourne, Franklin County, on June 26, 1897.

***Etheostoma cœruleum* Storer. RAINBOW DARTER; BLUE DARTER;
SOLDIER FISH.**

Head $3\frac{1}{2}$ or more; depth $4\frac{1}{4}$; eye 4 to $4\frac{1}{2}$. D. IX to XII-12 to 14; A. II, 7 or 8; scales 5-37 to 50-10. Body robust, rather deep and compressed. Head large, compressed. Mouth moderate, terminal, oblique, the lower jaw somewhat included; gill membranes not united. Cheeks naked

or nearly so, opercles scaled, neck and breast usually naked. Color, olivaceous, tessellated above; sides with a varying number (about 12) of vertical, indigo-blue bars, separated by orange interspaces; throat, breast and sides of belly orange; cheeks blue-green; first dorsal crimson at base, above this an orange bar, margined with blue; other vertical fins chiefly orange, tipped with blue. Females much plainer, with very little blue or red. Length $2\frac{1}{2}$ inches.

This elegant little fish is widely distributed over the state, and is generally abundant. It is most common in the smaller streams, and is always found in running water, usually on ripples, and does not occur in lakes. Kirtland reported it in 1854 from near Cleveland, under the name *Pocilosoma erythrogastrum*. Jordan gives it as "the most abundant member of the family." Hamilton County, "very common in East Mill creek," Henshall, 1888; Lorain County, "one of the most common darters," McCormick, 1892; Maumee river system, "not taken in the Maumee, St. Mary's and St. Joseph rivers, common in all the other larger streams and nearly all the small ones," Kirsch, 1893; Franklin County, abundant, of general distribution, Williamson and Osburn, 1897; Big Jelloway creek, "very common," Parker, Williamson and Osburn, 1898; John's creek at Ironton, Huron river at Milan, Ashtabula creek. Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river, at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, McMahan creek at Bellaire, R. C. Osburn, 1900.

The following variety of this species is also taken in Ohio :

***Etheostoma cœruleum spectabile* (Agassiz).**

It is known from the typical species by the "faded out" appearance of the ground color of the back, and by the arrangement of the olivaceous into distinct longitudinal lines. It is also rather more slender than the typical *cœruleum*, into which, both in color and in measurement it insensibly grades.

This variety is found in brooks and smaller streams, replacing to some extent the typical form in central and western Ohio. Specimens from Ohio streams show many intermediate stages. Recorded by Kirsch from Sugar creek, near Lima; Franklin County, taken only in the small streams, "grading insensibly into

the typical species," Williamson and Osburn, 1897; headwaters of Wabash river at Celina, Wolf creek near Dayton, brooks tributary to North Fork of Licking river near Newark, R. C. Osburn, 1899; Breakneck creek at Kent, tributaries of Grand river at Painesville, R. C. Osburn, 1900.

***Etheostoma tippecanoe* Jordan and Evermann.**

Head $3\frac{1}{2}$ to $4\frac{1}{4}$; depth $4\frac{1}{4}$ to $4\frac{3}{4}$; eye small, $\frac{1}{2}$ in head. D. XII-12; A. II, 7; scales 5 or 6-46 to 50-8; lateral line straight, developed on only about 30 scales. Body compressed, caudal peduncle deep. Head rather small, little compressed; mouth large, terminal, oblique, the lower jaw somewhat included; gill membranes scarcely connected. A small, well defined, black humeral scale. Cheeks, throat and breast naked; opercles scaled. Color in life, dark olive green, strongly tinged with yellow, especially posteriorly, passing into greenish yellow on belly; about 14 narrow, well defined, greenish black vertical bands encircling the body posteriorly; breast deep blue-black, the color extending forward on the throat and backward on the ventral fins; dorsal and anal fins golden yellow, pigmented with blue-black; pectorals plain golden yellow; ventrals golden yellow, blue-black at base. Female paler, no high colors, dark markings less distinct. Length $1\frac{1}{2}$ inches.

In Ohio this exceedingly rare darter has been taken only in Franklin County. Four specimens were taken by Mr. E. B. Williamson and the writer, one in the Olentangy river at Columbus, in September, 1896, the other three in Big Walnut creek near Lockbourne, on June 26, 1897. The species was taken in very swift ripples.

***Etheostoma flabellare* Rafinesque. FAN-TAILED DARTER.**

Head $3\frac{1}{2}$ to 4; depth $4\frac{1}{2}$ to 6; eye 4 to 5. D. VIII-12 to 14; A. II, 7 to 9; scales about 9-50-14. Body slender, compressed. Head long and pointed; snout not decurved, mouth very oblique, lower jaw projecting; gill membranes well connected. Fins all low, the first dorsal notably so, and, in the male, the spines tipped with fleshy knobs; caudal large, rounded. Head entirely naked; a narrow, bare strip along base of spinous dorsal. Color very dark olivaceous, forming vertical bars on sides; each scale with a dark center; dark humeral spot conspicuous; dorsal and caudal fins barred with black. Some Ohio specimens approach the variety *lineolatum*, characterized by distinct longitudinal lines along the rows of scales. Length $2\frac{1}{2}$ inches.

A common species in the clear, rapid streams of the state, found especially on ripples. Hamilton County, "common in East Mill creek," Henshall, 1888; Lorain County, "rare,

Vermillion river," McCormick, 1892; Maumee river system, St. Joseph river at Edgerton, Tiffin river at Brunersburg, Sugar creek at Lima, Beaver creek at Grand Rapids, Kirsch, 1893; Franklin County, nearly every stream, abundant, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, "a very common species," Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Lake Pippin, Cuyahoga river at Kent, Wheeling creek at Bridgeport, Ohio river and McMahon creek at Bellaire, R. C. Osburn, 1900.

Genus: BOLEICHTHYS.

***Boleichthys fusiformis* (Girard).**

Head $3\frac{1}{2}$ to 4; depth $3\frac{3}{4}$ to 6; eye 3 to 4. D. VIII to X-9 to 12; A. II, 6 to 8; scales 3-43 to 60-12. Body usually elongate, compressed. Head rather long and narrow; snout short, decurved; mouth terminal, lower jaw slightly included; premaxillaries not protractile; gill membranes connected. Cheeks, opercles, nape and breast usually scaled. Lateral line incomplete, high up, often interrupted. Color, olivaceous, the sides and back blotched with darker, pale below; in adult males the sides are usually flecked with crimson; base of caudal with 4 dark spots in a vertical row; spinous dorsal usually blue, with a median crimson band. An extremely variable species.

Jordan records the species for the state as "noticed only in tributaries of the Maumee, in Ohio." No other collector mentions it. However, it seems to be distributed over northern and central Ohio, in suitable localities. The writer has found it to be rather common in shallow water in Sandusky Bay, and has taken it also in the Huron river at Milan, 1899, and in Pippin and Summit lakes and in Licking reservoir, 1900.

Family: SERRANIDÆ.

Genus: ROCCUS.

***Roccus chrysops* (Rafinesque). WHITE BASS.**

Head $3\frac{1}{2}$; depth $2\frac{1}{2}$; eye 5. D. IX-I, 14; A. III, 11 or 12; scales 10-55 to 65-15. Body rather deep and compressed; back considerably arched. Head subconical; mouth moderate, nearly horizontal, lower jaw slightly projecting. Head scaled to between nostrils. Color, silvery, tinged with golden below; sides with narrow, dusky lines. Length 15 inches.

An abundant species in Lake Erie, ascending the larger tributaries to some distance. The species is said to be common in the lower Ohio, but no one seems to have noticed it within the limits of the state, though it probably ascends to that distance. Lake Erie, Henshall, 1889; Lorain County, "quite common in the lake, ascending the streams to the dams," McCormick, 1892; Maumee river at Grand Rapids, Waterville and Toledo, Kirsch, 1893; abundant in Lake Erie at Sandusky, rare in Huron river at Milan, R. C. Osburn, 1899.

Family: SCIÆNIDÆ.

Genus: APLODINOTUS.

Aplodinotus grunniens Rafinesque. SHEEPSHEAD; DRUM;
WHITE PERCH.

Head $3\frac{1}{2}$; depth $2\frac{3}{4}$; eye 3. D. X, 30; A. II, 7. scales 9-55-13. Body oblong; back much elevated and compressed; profile long and steep, straightish. Head slightly compressed; mouth moderate, subinferior. Lower pharyngeal bones fully united, with coarse, blunt, paved teeth. Color, grayish silvery, dusky above, sometimes very dark; back sometimes with dusky streaks along the rows of scales. Attaining a weight of 50 or 60 pounds.

An abundant species both in Lake Erie and the Ohio river, and ascending their larger tributaries to some distance. Kirtland, following Le Sueur, recorded the lake form as *Sciæna oscula*, and the Ohio river form as *S. grisea*. Jordan gives it as very abundant in Lake Erie, and also mentions it for the Ohio. Hamilton County, "abundant in Ohio river," Henshall, 1888; Lorain County, "very common in the lake, Vermillion river, Black river," McCormick, 1892; Maumee river at Defiance, Grand Rapids, Waterville and Toledo, west end of Lake Erie, Kirsch, 1893; Muskingum river at McConnellsville, Prof. D. S. Kellcott; Ohio river at Iron-ton, Huron river at Milan, Lake Erie at Sandusky, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900.

*Family: COTTIDÆ.**Genus: COTTUS.***Cottus ictalops** (Rafinesque). MILLER'S THUMB; SPRING FISH.

Head about $3\frac{1}{3}$; depth 4 to 6; eye 4. D. VI to VIII-16 or 17; A. about 12; ventral fin I, 4, the spine slender and closely attached to the first ray. Body stout anteriorly, tapering regularly back to the slender caudal peduncle. Skin smooth, except just behind the pectorals, where it is beset with very small, sharp prickles, these sometimes obsolete; lateral line conspicuous. Gill membranes not meeting across the very broad isthmus. Olivaceous, more or less barred and speckled with darker; fins mostly barred or mottled. Quite variable. Males in breeding season with a wide, black bar margined with orange on dorsal fin, and under side of head pigmented with dark or blue-black. Length 3 to 7 inches.

Widely distributed, but never abundant; sometimes locally common. It occurs in clear, cold brooks and rapid streams. Recorded as *Cottus bairdii*, by Girard, from specimens taken by Spencer F. Baird, in Mahoning river at Poland. Given by Jordan as *C. richardsoni*; Lorain County, common in Spring brook and Chance creek, McCormick, 1892; Maumee river system, St. Joseph river at Edgerton, Kirsch, 1893; Franklin County, four specimens from Brackenridge's Run, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, Parker's Run and Black's Run, common in the latter, Parker, Williamson and Osburn, 1898; a small brook tributary to North Fork of Licking river at Newark, R. C. Osburn, 1899.

*Family: GADIDÆ.**Genus: LOTA.***Lota maculosa** (Le Sueur). BURBOT; LING; LAKE LAWYER.

Head $4\frac{1}{2}$; depth $5\frac{1}{2}$; eye 7. D. 13-76; A. 68; scales very small, embedded. Body elongate, not much compressed anteriorly. Head slightly depressed; mouth large; a single barbel on the chin. 30 pyloric coeca. Color, dark olive, thickly marbled and reticulated with blackish; below, yellowish or dusky. Length about 2 feet.

Common in Lake Erie, not recorded elsewhere in the state. Recorded for Lake Erie by Le Sueur, 1817, by Kirtland, 1838; by Henshall, 1888, and by McCormick for Lorain County, Lake Erie, 1892; Sandusky, R. C. Osburn, 1899 and 1900.

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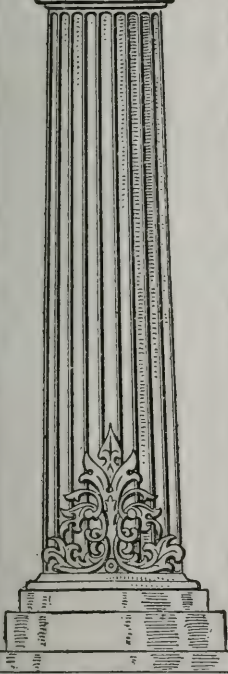
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O H I O
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A C A D E M Y
of S C I E N C E



Tenth Annual Report

TENTH ANNUAL REPORT

OF THE

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Total members 165

HISTORICAL SKETCH.

The Ohio State Academy of Science was organized at Columbus on December 31, 1891. The preliminary step which resulted in this organization was taken at the suggestion of Prof. W. R. Lazenby, by the Biological Club of the Ohio State University, which, on November 3, 1891 appointed a committee consisting of D. S. Kellicott, W. A. Kellerman, and W. R. Lazenby to take such action as was necessary to bring together the scientists of the state. This committee issued the call for the first meeting, at which a permanent organization was effected. The temporary officers were the following: chairman, A. M. Bleile; secretary, W. R. Lazenby; committee on organization, constitution and by-laws, W. A. Kellerman, E. M. Claypole, and Henry Snyder; committee on nominations, L. H. McFadden, E. E. Bogue, A. D. Selby, Henry Snyder, and W. A. Kellerman.

The Academy began its existence with fifty-nine charter members and was incorporated under the laws of Ohio in 1892 with W. R. Lazenby, W. A. Kellerman, F. M. Webster, A. D. Selby, W. C. Werner, and E. E. Bogue as incorporators.

The annual (winter) meetings have been held at the following places: 1891, 1892, 1893, 1894 at Columbus; 1895 at Cincinnati; 1896, 1897, 1898 at Columbus; 1899 at Cleveland, 1900, 1901 at Columbus.

Field (summer) meetings have been held at Akron in 1892, at Logan in 1893, at Granville in 1894, at Sandusky in 1895, at Oxford in 1896, at Brinkhaven in 1897, at Dayton in 1898, at Columbus in 1899, at Put-in-Bay in 1900, and at Wooster in 1901.

J. H. S.

CONSTITUTION AND BY-LAWS OF THE ACADEMY.

CONSTITUTION.

ARTICLE I.

This Association shall be called The Ohio State Academy of Science.

ARTICLE II.

The object of this Academy shall be to encourage scientific research, and to promote the diffusion of knowledge in the various departments of science.

ARTICLE III.

Members may be elected at any meeting of the Academy, and shall sign the constitution and pay an annual fee of one dollar; but the secretary and treasurer shall be exempt from the payment of dues during the year of their service. Any member may at any time commute all future dues by the payment of twenty-five dollars. At any regular meeting Honorary Members may be elected, on account of special prominence in science, on the written recommendation of five members of the Academy. In any case, a two-thirds vote of members present shall elect to membership. Applications for membership shall be made in writing, countersigned by two members, and referred to a committee on membership, who shall consider such application and report to the Academy before the election.

ARTICLE IV.

The officers of this Academy shall be chosen by ballot at the annual meeting, and shall consist of a President, two Vice Presidents, Secretary and Treasurer, who shall perform the duties usually appertaining to their respective offices. The Secretary and Treasurer shall be re-eligible. The President, Secretary, Treasurer and two elected members, shall constitute an Executive Committee.

Amendment to Article IV.

There shall be a Board of Trustees consisting of three members; one elected for one year, one for two years, and one for three years; and thereafter one elected annually for three years. It shall be the duty of this Board of Trustees to act as the cus-

todian of all property of the Academy and to administer all funds received for original research and investigation.

ARTICLE V.

Unless otherwise directed by the Academy, the annual meeting shall be held at such time and place as the Executive Committee may designate. Other meetings may be called at the discretion of the Executive Committee.

ARTICLE VI.

This constitution may be altered or amended at any annual meeting, by a three-fourths majority of attending members. No question of amendment shall be decided until one year after the meeting at which it was proposed.

BY-LAWS.

ORDER OF BUSINESS.

1. The first hour, or such part thereof as shall be necessary, in each session, shall be set aside for the transaction of the business of the Academy. The following order of business shall be observed, as far as practicable:

- (1) Opening.
- (2) Reports of Officers.
- (3) Reports of Committees.
- (4) Unfinished Business.
- (5) New Business.
- (6) Election of Officers.
- (7) Election of Members.
- (8) Reading and Discussion of Papers and Addresses.
- (9) Adjournment.

NOTICE OF MEETINGS.

2. No meeting of this Academy shall be held without publication of a notice of the same by the Secretary at least thirty days previously.

PAYMENT OF BILLS.

3. No bill against the Academy shall be paid by the Treasurer without an order from the Executive Committee.

UNPAID DUES.

4. Members who allow their dues to remain unpaid for two years, having been annually notified of their arrearage by the Treasurer, shall have their names stricken from the roll.

QUORUM.

5. Twelve members shall constitute a quorum for the transaction of business.

EX-OFFICIO MEMBERS.

6. The President and Secretary of designated scientific societies of the State shall be *ex-officio* members of the Academy, on acceptance of such membership by their society.

ADDRESS BY PRESIDENT.

7. The President shall deliver a public address during the course of the Annual Meeting over which he presides.

Amendment Passed November 29, 1901.

The President's annual address, beginning with the year 1901, shall be published in the annual report.

COMMITTEE ON MEMBERSHIP.

8. At the first session of each annual meeting, the President shall appoint a Committee on Membership, consisting of three members, which shall report upon all applications for membership.

COMMITTEE ON NOMINATIONS.

9. On the first day of the annual meeting the Academy shall elect a Committee consisting of three members, which shall report nominations of officers and members of the Executive Committee at the last session of the annual meeting.

COMMITTEE ON PROGRAMME.

10. A committee consisting of two members shall be appointed by the President-elect at the last session of each Annual Meeting, whose duty shall be to issue, in conjunction with the Secretary, a notice of the annual meeting at least one month in advance. The committee shall prepare and issue, at least ten days in advance of the meeting, a general programme giving title and time required for presentation of each paper.

COMMITTEE ON PUBLICATION.

11. A committee on publication, consisting of three members, shall be elected by the Academy, one member to be elected each year at the annual meeting to serve for three years. This committee shall be empowered to call on specialists in the various departments, if needed.

COMMITTEE ON COLLECTIONS.

12. A permanent committee of three members on Academy Collections shall be appointed when necessary. It shall be the duty of this committee to secure and take charge of all collections for the Academy.

AMENDMENTS.

13. These By-Laws may be amended by a two-thirds vote of the members present.

Motions and Resolutions Having the Effect of By-Laws.

PUBLICATION OF SPECIAL PAPERS.

Resolution adopted December 29, 1897.

Resolved, That the Committee on Publication be authorized to publish from time to time, as material and funds may warrant, a series of Special Papers, from among those presented at the meetings of the Academy. The size of page to be uniform with that of the Proceedings.

The series to be entitled, Ohio Academy of Science, Special Papers No. 1, 2, 3, etc. The papers to be issued without additional expense to members of the Academy who are in regular standing. The author to have 25 copies free. The remainder of the edition to be offered for sale at the lowest reasonable rate.

The cost of illustrations to be borne by the author.

Notice of the papers in stock to be given on the annual programs and Proceedings.

LIBRARIAN.

Motion carried December 23, 1899.

Moved that the trustees be instructed to appoint a librarian who shall have charge of distribution of publications and who shall arrange an exchange with other societies and receive and list all

exchanges. Exchanges so received shall be accessible to all members for consultation, or may, upon payment of transportation charges, be withdrawn for reasonable periods of time.

LIST OF MEMBERS.

Motion carried December 29, 1896.

It shall be the Treasurer's duty to furnish the Publication Committee a correct list of members for the annual report.

E. L. MOSELEY,

L. H. MCFADDEN,

W. R. LAZENBY,

Committee on Codification.

REPORT OF THE ELEVENTH ANNUAL MEETING
OF THE
Ohio State Academy of Science.

ANNUAL MEETING.

The eleventh annual meeting was held at the Ohio State University, Columbus, November 29 and 30, 1901. This being a month earlier than the usual time, the executive committee were gratified to find the attendance good as usual, though a few others might have planned their work so as to be present, had the date been announced earlier in the year. The papers read were, for the most part, not technical, but interesting to all who heard them. The joint session Friday evening of the Academy of Science and the Modern Language Association of Ohio was both instructive and interesting, to members and guests.

Profesor Eggers, secretary of the Modern Language Association, stated that the Association had tried different times of the year for its annual meetings, but had found Thanksgiving week decidedly the most suitable. The prevailing sentiment among members of the Academy was also in favor of holding its meetings then. The principal objections raised were the meetings at that time of teachers' associations in other parts of the state and the detention of some members at home by college duties.

"In view of the fact that the attendance at the field meetings for the last six years had been small except when held in connection with the meeting of some other association" the secretary recommended "that we abandon the policy of holding a field meeting every year and, without fixing a longer period, leave the matter to be decided each year by the executive committee." The Academy voted to

leave the matter of holding a summer meeting to the discretion of the executive committee with power to act.

The following amendment to the by-laws, offered by Mr. Schaffner, passed:—“The president’s annual address, beginning with the year 1901, shall be published in the annual report.”

In pursuance of a resolution a committee of three,— E. L. Moseley, L. H. McFadden and W. R. Lazenby — was appointed by the president to codify and publish the constitution and by-laws as now existing.

Discussion of the question, “In what manner may the Academy become more serviceable to the scientific interests of the State?”, led to the appointment of a committee, consisting of the president, treasurer and secretary, to make recommendations concerning the printing of the Academy’s reports by the State and concerning the transmission of natural history specimens by mail. At the last session the committee made the following recommendations, which were adopted:

“Your committee to consider the question of methods for increasing the facilities of the Academy for publication would recommend that the executive committee be requested to consider the question in its various aspects and, if deemed desirable, to take the necessary steps to secure legislative action for State assistance in this direction.

“That the Academy through its secretary respectfully represent to the postal authorities that the present provisions and rulings of the postal department regarding transmission of natural history specimens are inconsistent and a serious hindrance to exchange of scientific material and urge that better provisions be afforded.”

Mr. Webster read a letter from Emerson E. McMillin again placing \$250 at the Academy’s disposal.

Eighteen applicants for membership were elected.

The progress of the topographic survey during the past season was described by Professor C. N. Brown, who exhibited a map of the state on which were shown in colors the quadrangles in which the field work has been com-

pleted, those in which it is partly done, and the additional ones covered by primary control. He stated that the atlas sheets for the territory surveyed in 1901 would be engraved and printed by the U. S. Geological Survey and probably completed by the latter part of the summer of 1902.

The report of the committee on Topographic Survey prepared by Albert A. Wright, the chairman, was read by Lynds Jones. In conclusion it says:

"It is very desirable that the members of the Academy and all other supporters of the survey, should make known to their representatives in the Legislature and to the Governor and other officers of the State their desire that this work, so well inaugurated, should be followed out to its completion, in the mapping of the entire area of every county of the State."

PAPERS READ.

1. New Fossils, including Sea-weeds, two new genera, Carboniferous, Marietta; Land Plants, two species, Carboniferous, one species, Corniferous; Corals, fifteen Cyathophylloids, Corniferous; Brachiopods, one, Corniferous; Cephalopods, six, Corniferous. - - - - - H. HERZER
2. Notes on the timber trees of Ohio - - - - - WILLIAM R. LAZENBY
3. The self-pruning of woody plants - - - - - JOHN H. SCHAFFNER
4. The Ohio species of Phyllachora - - - - - W. A. KELLERMAN and J. G. SANDERS
5. A striking case of mimicry, with exhibition of specimens - - - - - HERBERT OSBORN
6. Smut infection experiments - - - - - W. A. KELLERMAN and O. E. JENNINGS
7. Further observations on the preglacial drainage of Wayne and adjacent counties - - - - - J. H. TODD
8. The weight, waste and composition of apples - - - - - WILLIAM R. LAZENBY
9. Plant ecology of Ohio; a general outline - - - - - JOHN H. SCHAFFNER and FRED J. TYLER
10. Observations on the flora of the Gauley Mountains, West Virginia - - - - - W. A. KELLERMAN
11. Preliminary list of tamarack bogs in Ohio - - - - - A. D. SELBY

12. Report for 1901 on the State Herbarium with additions
to the Ohio Plant List - - - W. A. KELLERMAN
13. Modern Languages and Science in High School Course
- - - - - WILLIAM WERTHNER
14. Botanizing in Colorado Mountains. Illustrated - -
- - - - - A. D. SELBY
15. Some notes on a trip to southeastern Siberia - - -
- - - - - GERARD FOWKE
16. Notes on Hemiptera with some records of species new
to the Ohio list - - - - - HERBERT OSRORN
17. Observations on some South American Hemiptera, with
exhibition of specimens - - - - - HERBERT OSBORN
18. A species of Diptera mining the leaves of wild rice at
Sandusky - - - - - JAS. S. HINE
19. Experiments with chemicals to improve seed germin-
tion - - - - - W. A. KELLERMAN and F. M. SURFACE
20. A possible cause of osars - - - - - G. H. COLTON
21. The introduced species of *Lactuca* in Ohio - A. D. SELBY
22. Gradations between *Verbena stricta* and *Verbena an-*
gustifolia - - - - - THOS. A. BONSER
23. New plants for the Ohio Catalogue - - - A. D. SELBY
24. Observations on the origin of forest belts in Clay
County, Kansas - - - - - JOHN H. SCHAFFNER
25. A report on the Revised Catalog of Ohio Birds LYNDY JONES
26. The summer birds of Lake Erie's Islands - LYNDY JONES
27. Perverted Benevolence - - - - - GERARD FOWKE
28. Notes on *Anthurus borealis* and *Erysiphe graminis* -
- - - - - W. W. STOCKBERGER
29. Report on the ecology of Big Spring Prairie - T. A. BONSER
30. Some aspects of plant growth as illustrated by methods
of watering - - - - - W. J. GREEN
31. A plasmodium found in the blood of a turtle and related
to the plasmodium of malaria - - - C. B. MORREY
32. An Insect pest new to Ohio (Read by title), F. M. WEBSTER
33. The trend of insect migration in America (Read by
title) - - - - - F. M. WEBSTER
- President's address—The Future of Vegetable Path-
ology - - - - - A. D. SELBY

E. L. MOSELEY, *Secretary.*

FIELD MEETING.

The field meeting was held at Wooster May 31 and June 1, 1901. The weather was pleasant and a goodly number of local naturalists took part in the excursions, but only three members came from a distance. A few others had expressed an intention of coming but were prevented by the rainy weather preceding the meeting or by other causes.

The bog around Brown's Lake, west of Shreve, proved very interesting to botanists and the adjacent woods to ornithologists.

The second day was spent in visiting the Agricultural Experiment Station and, by a change of plan, driving up the Killbuck valley, where were found many things interesting to geologists, archaeologists, botanists and ornithologists.

E. L. MOSELEY,
Secretary.

IN MEMORIAM.

EDWARD WALLER CLAYPOLE, D. SC.

June 1, 1835 — August 17, 1901.

Dr. Claypole died on August 17, 1901, at Long Beach, California, while spending a few vacation days at the seashore with his family.

The Ohio State Academy of Science owes to him a great debt for his zealous labors in its behalf. He was one of the influential promoters of its organization, and up to the time of his removal to California in 1898 he was one of the most honored leaders in all its activities. He served as its first president in 1892. His frequent contributions, both in the form of papers and in the discussion of subjects introduced by others, were always promotive of a high level of work and thought in the sessions of the organization.

Dr. Claypole was born in England in 1835. He was educated at the University of London, where he received

the degrees of A. B. in 1862, S. B. in 1864, and Sc. D. in 1888. He was well known in England as a geologist, and some of his scientific papers written in this country were published there. He came to America in 1872 and served as Professor of Natural Sciences in Antioch College, at Yellow Springs, Ohio, from 1873 to 1881. For two years he was paleontologist to the Pennsylvania Geological Survey, and published the report on the Geology of Perry County. From 1883 to 1898 he was Professor of the Natural Sciences in Buchtel College at Akron, Ohio. On account of the failing health of his wife, he resigned this position and sought a southwestern climate. During the last three years of his life he was Professor of Geology and Biology in Throop Polytechnic Institute at Pasadena, California.

The range of his studies and of his knowledge was very wide. He was not only a contributor to the facts and general principles of Geology and Paleontology, but was at home in various branches of Zoology and Botany, and was versed in the principles of Chemistry and Physics. He was a Fellow of the Geological Societies of America, London and Edinburgh, and of the American Association for the Advancement of Science. He was a member of the American Entomological Society and of the American Microscopical Society. He was an associate editor of the *American Geologist* from its beginning in 1888. To the paleontology of Ohio he contributed some important descriptions of Devonian fishes, enlarging the bounds of the striking fauna first made known by Dr. Newberry.

His personal qualities were such as to draw others to him in a remarkable degree. He was the personification of modesty, simplicity and sincerity, and at the same time a fountain of overflowing regard for others. His comprehensive interest in the problems of science, and his delight in the companionship of others, enabled him to inspire his pupils and to exert a stimulating influence upon his associates. In speaking, his thought was always clear and consecutive, his language was choice English which came

without apparent effort, while his delight in his subject illumined his face, and his regard for his audience expressed itself in courteous and kindly tones that won the friendship of every hearer. He was deeply devoted to his wife and daughters, and their companionship in scientific fields was one of the chief joys of his life.

In his death, we feel that science has lost a distinguished devotee, and the Academy a friend whose memory it will long cherish.

A. A. WRIGHT,
H. HERZER,
L. H. McFADDEN,
Committee.

PRESIDENT'S ADDRESS.

THE FUTURE OF VEGETABLE PATHOLOGY.

A. D. SELBY.

On this occasion, as President of the Ohio Academy, it is incumbent upon me to deliver an address, presumably upon some phase of the body of knowledge we call science. Custom points no less unerringly to some topic along the lines of one's chosen pursuit. Doubtless, without any announcement a botanical heading would be assigned to this occasion. For various reasons it has seemed fitting to present to you some thoughts on "The Future of Vegetable Pathology." Certainly this cannot be done without considering the history of the rise and progress, nor without discussing the present status of plant pathology both from the standpoint of the investigator and of the teacher. These matters are likely to lead to estimates concerning the rank of vegetable pathology among the divisions of botanical science.

Concerning the speaker personally it is known to most of you that his pursuits are along the line of the study and investigation of plant diseases. Since it is in the cultural aspects of plant life rather than in the original condition of wild plants that pathology has claimed the largest attention, we naturally look to that phase for much of its history. The advance of our knowledge in this helpful line has certainly been gratifying, during the closing decade of the nineteenth century.

Plants, as dynamic factors, exhibit certain general and normal activities, discernible under widely different conditions of environment and recognizable in plants of external dissimilarity, the study of these normal activities leads us to Plant Physiology. At the same time these plants in their usual activities are impinged upon by certain special and general phases of environment, by varying

climatic conditions embracing differences in the amounts of heat, light and humidity, exposure to dryness in air or soil as well as the encroachments of animal life by the cropping of herbivores or the fretting of insects. In response to continuously acting stimuli of this character the plants become modified or adapted to the conditions surrounding them; the study of this adaption leads to Ecology.

Studying still these same plants as living organisms, and either in their general functional activities or in their external and internal adaptations or in both, we find that the course of the life of the plant is by no means always normal—instead of simple turgor we may have tumescence or edema (dropsy as our physicians would say); instead of the free water flow contemplated through the conducting tissues we may find the vessels closed. Not only this, external and internal parasites may attack any and all organs of the plants, intercepting light and heat, absorbing, destroying or diverting the usual nutritive substances, penetrating and transforming essential organic tissues, and even totally preventing the attainment of the reproductive functions; these parasites may lie in wait in the soil, be wafted in the winds, or be sown with the seed of the husbandman. Otherwise incapable of striking expression by external signs, the plant may find itself fixed in a soil with inadequate or unsuitable, or even injurious substances contained therein; accordingly there is stunted growth, reduced vigor or manifest ill health indicated by fruit or foliage. Abnormalities are seen in such and in other ways; their study just as certainly leads us to Vegetable Pathology.

Pathology is then, at least, tentatively ranked coordinately with Physiology and Ecology among the divisions of botanical science which have to do with plants in their life relations. No one of these divisions just enumerated, more than another, may be successfully cultivated without some knowledge of the other divisions of botany and of allied sciences.

Historically, Vegetable Pathology has been studied for a long time; at least one work on "Maladies des Plantes" has a title page date of the early fifties. Of two German works in the nature of general treatises on this subject, still useful, the first editions were issued in the years 1874 and 1880 respectively; I refer to the handbooks of Sorauer and Frank, both of which have passed through subsequent editions. The lamented Winter's little work "Die durch Pilze Verursachten Krankheiten der Kultur-Gewächse," belongs to about the same period (1878). These were followed by almost synchronous publication of the works by Prilleux, Hallier, Tubeuf, Berlese and Marchal in French, German and Italian respectively. Tubeuf's book was soon translated into English by Smith, and its appearance in that dress has been followed by the handbook of Massee and by the recent and most excellent work by H. Marshall Ward under the title of "Disease in Plants."

There are journals, too, including the *Zeitschrift für Pflanzenkrankheiten*, edited by Sorauer, now in its eleventh volume, the *Zweite Abteilung* of the *Centralblatt für Bakteriologie und Parasitenkunde*, now in its sixth volume. The Italians have the "*Rivista di Patologia Vegetale*," of many years' standing, edited by Berlese, and the Dutch the "*Tidschrift over Planten Ziekten*," edited by Ritzema-Bos. In England society proceedings and journals have been the chief avenues of publication for work on plant diseases; while in the United States, aside from the *Journal of Mycology* instituted by Dr. Kellerman while in Kansas, now no longer published, the publications of the United States Department of Agriculture and the various Experiment Stations in the several states have been the chief agencies by which a large and valuable literature on plant diseases has been issued.

Looking at the subject in this manner we are led to conclude that plant pathology has possessed a well arranged and systematic body of facts bearing upon the subject during a period of at least twenty years, and that this body of knowledge has been accessible for that length of time in

the form of published handbooks; and further that it has possessed, and still possesses, a large literature issued in periodical form and covering the multitudinous phases of the subject in question.

Has plant pathology meanwhile assumed the coordinate rank herein indicated along with plant physiology and ecology? I fear we must answer negatively in so far as college professorships and university courses are concerned. Aside from the few universities which offer rather brief undergraduate courses in "Vegetable Pathology" or in "Plant Diseases," most, or I might say all, American university and college courses offered by well developed botanical departments consisting of two or more chairs in botany, are silent on this subject.

If the elements of the subject are taught at all they are either presented under plant physiology or the systematic study of fungi, and it is notable that in America's oldest and largest university this division of botany is not recognized as existing. Professor Ward, to whom reference has already been made, responds in a recent letter that his work in plant diseases is all research work and that he offers no separate course upon the subject.

It is easy to understand that up to a recent time no well formulated call had been made for students equipped in this line, and that, therefore, no demand existed for courses in plant pathology, but certainly the recent expansion in experiment station work, and in that of the United States Department of Agriculture, no longer leaves this position tenable. The writer has sometimes wondered whether we have in this tardiness to apply botany in vegetable pathology a sort of unwillingness, or reluctance to place applied science upon a coordinate basis with pure science. Many are aware how relentless was the opposition of the representatives of the old education to putting engineering, or applied science courses upon the same basis as the arts course for graduation. Indeed, if I am not mistaken, certain institutions still discriminate against graduates in engineering. Seeing that all this is history, and noting that

applied science in the domain of living things offers greater difficulties than the sciences applied in engineering and other technological lines by reason of the variations in the organisms themselves, it ought not to surprise us that this applied botany should make at times slow advances. Such has been the case all along the line of agricultural application. It would not be against some things that have already passed into history were the lingering, or inherent hostility to useful knowledge as a part of the subject matter of collegiate instruction to have had something to do with the tardy recognition given to plant pathology in this, the foremost country of the earth, in the application of the remedial methods, its study has brought to our people. A good many of us have heard the sneer often accorded to really fine work in applied botany.

However much weight we may give the foregoing considerations, it must not be denied that vegetable pathology as a well rounded division of botany has been compelled to pass severe tests, to suffer disadvantages.

The tendency in some quarters to restrict the application of the term vegetable pathology to a study of the cryptogamic parasites upon plants, has been a great drawback. Parasitology has been developed to the narrowing and dwarfing of the true science. Doubtless this is the idea which finds expression in the catalogued courses of "economic mycology." One well known and liberal minded botanist, himself a professor of botany, made the remark to me some two years ago, that he would acknowledge that we possessed a science of plant parasitology, but that the science of plant pathology seemed to him to require building up on the non-parasitic side before we could consider it a well developed division of the science of botany. I may mention here in passing that the development in this country of economic entomology, apart from botany, wherein its application rests if it attain economic rank as to plants, has also divided forces when compared with the course of events in Germany and the remainder of Continental Europe.

Granting that the immediate demands for it and the recognized value of the results of the study of fungus parasites has developed the science unequally or disproportionately in that direction recent advances have certainly tended in a large measure to correct this tendency. While we do not yet know the exact interrelations out of which harm results from the unlocking of oxydizing enzymes at unpropitious times, as is now believed to be true in yellows of the peach and in the mosaic disease of herbaceous plants, notably of tobacco, progress towards a knowledge of this abnormal "stoffwechsel" has certainly been rapid and has apparently proceeded along safe lines. That many normal processes in plants remain obscure or unsolved does not discourage the plant physiologist; no more should the obscurity of the abnormal deviations cause the plant pathologist to desist from his triumphant progress.

A prominent plant physiologist has recently asserted that an adequate explanation of so simple and fundamental a process as the ascent of sap in plants yet remains to be proposed; other problems in physiology are stated to be equally unsolved. In like manner the vegetable pathologist finds himself with respect to some of the problems of pathology. Unsolved problems there are, and unsolved problems there will remain so long as men continue yearly to extend the boundaries of our knowledge of plant life.

I feel well assured that the state of our knowledge warrants us in recognizing plant pathology as a well established division of botanical science entitled to the coordinate rank I have earlier indicated. If this be granted then what reasonable grounds exist to warrant the arrangement of courses and the establishment of chairs of vegetable pathology? I think the basis of our modern education affords us but one answer. The state charges itself with educational matters in order that her citizens may be more useful in perpetuating the state and in contributing to its welfare and prosperity. The state is already demanding the services of those who are capable of assisting agriculture by controlling the diseases of culture plants; with the lapse

of years these demands promise to develop in increasing proportions.

The institutions of learning which leave their graduates without all the training for this work that the state of our knowledge affords are missing one of the fairest opportunities for usefulness. The graduate who finds that his notes on economic mycology fail to connect his parasites adequately with the changes in its host, will probably accuse his instructor of leaving him to find out for himself what he should have been taught in some general manner, at least, while he had a student's leisure and before the unceasing demands of actual service pressed upon him. Generally speaking, American institutions leave the student in this position or offer him an excellent opportunity to make his own pathological inferences from physiological instruction. In my judgment the demand for well considered instruction and research in plant pathology, is already formulated and only awaits avenues of expression to make itself felt. It would seem that the Land Grant Colleges and State Universities are situated at a great advantage by their opportunities in the line of courses in a pathological botany that shall be pedagogically sound and actually immediately helpful. They have this fine opportunity because of their relations to the state at large and to the agricultural community in particular, and by either direct or contributory connection with the experiment stations and the United States Department of Agriculture. Have such courses been made prominent and are these great institutions realizing their full opportunities? And are the time and facilities in the way of helpers allotted in our State University or elsewhere, such as make nothing more to be desired? To both of these questions most would give either a qualified or unqualified negative answer. So long as this is true much remains to be done for the future of vegetable pathology. It may be added that so far as my own inquiries and those of certain of my friends have extended, we find plenty of disposition to create separate chairs in botany in our universities and properly so, but there is little manifest disposition to pro-

vide adequately for instruction in plant pathology. If we contrast this apparent indisposition, I say *apparent* advisedly, for those on the outside can judge as to what is being considered within only by announcements, if, I repeat, we contrast this apparent indisposition of the institutions training for the future physicians of the plant world, with that existing in medical colleges wherein there is a very concrete division of pathological subjects, we are forced to conclude that a great deal remains to be done to provide adequately for the future instruction that I am well assured is to be given in vegetable pathology.

A body of well organized knowledge on plant diseases presented by teachers charged chiefly or solely with the giving of courses or the conduct of investigations in plant pathology is, I am led to believe, not solely by the course of demand for workers, but as well by the development of our agricultural practice, to be the future of vegetable pathology. In so far as I am aware, the only university whose officials have, as yet, expressed a desire and future purpose to put plant pathology on this foundation for the future, is not as one would expect endowed by public funds, but by private philanthropy. I am hopeful that this will not long remain the case.

In choosing this subject and in the manner of presenting it, I have been guided as herein set forth inadequately, by a desire to make plain the disproportion between the demands, in the line of applied botany, made upon many of the most competent graduates in botany and in the preparation they have been given for this work. It is recognized that at no other period of the world's history have the universities of the time been subjected to such stress and expense in equipping for the demands of instruction, as have fallen upon those of our own day within the last two decades, more especially within the last one. Under these circumstances with the achievements of applied physical and chemical science in the minds and on the lips of the inhabitants of both town and country, it is not surprising that the equally important economic achievements in

botanical science, and especially in pathology should have passed without much consideration by a great number whose interests and training lead them to look elsewhere. What has been stated has been offered in the spirit of friendly suggestion and with no desire to misstate or misapply the facts as they now exist. Should this appear to have been done it will be my greatest pleasure to make corrections.

It is quite generally recognized at the present day that some of the brilliant hopes of the chemist respecting improvement in plant growth, have failed of realization, and that after all the sciences which deal with living things have their problems worthy the most competent and best equipped of our scientists. The chemist will now admit that mere chemical analysis of the plant substance gives no adequate knowledge whereby we may solve the vexing problems of plant nutrition, valuable and helpful as the analysis has been. We, as botanists, are justified in the faith that our beloved science is at last to come into possession of her full heritage of problems as well as opportunities. Certainly the unrivaled development of American botany in recent years justifies a faith of this sort.

I have thus with hasty preparation, and as I am well aware, very imperfectly as to result, taken this much of your valuable time in discussing what appears clearly to me to be the larger possibilities of the Future of Vegetable Pathology.

Ohio Agricultural Experiment Station, Wooster, Ohio,
November, 1900.

SOME BOOKS ON DISEASES OF PLANTS.

1853—1901.

[In the following incomplete list it has been the aim to include only general treatises upon Diseases of Plants. The works of Dr. Hartig by reason of their classical character are included, though relating to trees only.]

1853. Payen, A.: *Les Maladies des pommes de terre, des betteraves, des bles et des vignes*, de 1845-1853, etc. Paris, 1853.

1874. Sorauer, Paul: *Krankheiten der Pflanzen*. 1874.

1874. Hartig, Robert: *Wichtige Krankheiten der Waldbäume*, etc., pp. 127; 6 plates, 4°, Berlin, 1874.

1878. Winter, George: *Die durch Pilze verursachten Krankheiten der Kultur-gewächse*. pp. 151, 8°, Leipzig, 1878.

1880-1. Frank, A. B.: *Die Krankheiten der Pflanzen*. Vol. I, pp. 1-400; II, pp. 401-844; 8°, Breslau, 1880-1.

1882. Hartig, Robert: *Lehrbuch der Baumkrankheiten*, pp. 198; 11 plates, 8° Berlin, 1882 (Also English translation by Somerville, 1883).

1884. Smith, Worthington G.: *Diseases of Field and Garden Crops, chiefly such as are caused by fungi*. 16°, London, 1884.

1886. Sorauer, Paul: *Handbuch der Pflanzenkrankheiten*, 2. Aufl. Text, 2 Vols.: I *Die Nicht-parasitären Krankheiten*, pp. 920.

II *Die parasitären Krankheiten*, pp. 456, 8°, Berlin, 1886. *Atlas Folio Portfolio*, 48 plates.

1889. Ward, H. Marshall: *Diseases of Plants*, London, 1889.

1895. Frank, A. B.: *Die Krankheiten der Pflanzen*, 2. Aufl. 8° 1895-6, 3 Vols.

I. *Die durch anorganische Einflüsse hervorgerufenen Krankheiten*, pp. 12-134, Ills., 34. 1895.

II. Die Pilzparasitären Krankheiten, pp. 61574, Ills., 1896.

III. Die Tierparasitären Krankheiten, pp. 6-363, Ills., 86. 1896.

1895. Berlese, A. N.: I parassite vegetale delle piante coltivate o utile, pp. 302, Ill., Milano, 1895.

1895. Tubeuf, Karl Freiherr von: Pflanzenkrankheiten durch Kryptogame Parasiten verursacht, pp. 7-599. Ills., 306, 8°, Berlin, 1895.

1895. Hallier, E.: Die Pestkrankheiten der Culturgewächse, etc., pp. 15-144, Stuttgart, 1895.

1895. Prilleux, Ed.: Maladies des plantes agricoles et des arbres fruitiers et forestiers causes par des parasites vegetaux, 2 vols. 8°: I, pp. 15-425, Ills., 190. 1895. II, pp. 15-902, Paris, 1897.

1896. Marchal: Les Maladies cryptogamique des plantes cultivees, pp. 16-104., Ill., 8°, Brussels, 1896.

1897. Tubeuf, Karl Freiherr von, translated by William G. Smith. Diseases of Plants due to Cryptogamic Parasites; 8°, London, 1897.

1899. Massee, George: A Text-book of Plant Diseases caused by Cryptogamic Parasites; pp. 500; 8°, London, 1899.

1901. Ward, H. Marshall: Disease in Plants, pp. 9-309; 8°, London and New York. 1901.

PAPERS AND ABSTRACTS.

SMUT INFECTION EXPERIMENTS.

W. A. KELLERMAN AND O. E. JENNINGS.

This paper gave the results of a series of experiments on the comparative susceptibility of several smuts. It is published in *The Ohio Naturalist*. Vol. II.

THE REVISED CATALOG OF OHIO BIRDS.

LYNDS JONES.

Members of the Academy will recollect that at our last winter meeting I spoke with no little earnestness of the great need of revising the catalog of Ohio birds, and they will also remember that at that time the chief response to the appeal was the information that Mr. Oliver Davie already occupied the field. A personal visit to Mr. Davie convinced me that his work was not to be a catalog of Ohio birds, but another of the many popular books upon the general subject with an Ohio setting. I was therefore glad to undertake the work of preparing the revised catalog when Professor Webster, acting for the committee which has in charge the distribution of the McMillin fund, offered financial encouragement.

As a beginning upon that work a list of the birds known to occur, or likely to occur within the state was prepared, printed, and distributed. From various directories and personal correspondence some 200 names were secured, mostly of persons now living in the state, 120 of whom expressed their willingness to cooperate with me in the work. Accordingly lists were sent to them. Of the 120 sent out 58, or a little less than one half have thus far been returned.

These 58 returned lists represent 35 counties, while my own work covers two other counties, making the total num-

ber 37. The number of species reported on these lists range from 263, for Hamilton to 14 for Allen (which latter was only a partial report upon a list for another county). The lists reporting less than 100 species number 25; between 100 and 200, 29; more than 200, 8. Average, 125. More than half of the counties from which reports have been received are therefore well represented, while few are poorly so.

A discouraging feature of the majority of the reports is the evident general ignorance on the part of those reporting, of the breeding of many of the species which should be found breeding in their county. This ignorance is shown in many ways, and is pretty clearly due to a cessation of field work with the advent of warm weather and mosquitoes. I had hoped that a good deal of information upon that point could be gained. Most people feel something of the excitement of the season of migration of birds, but it takes some planning and inconvenience to hold to the study after the excitement has passed.

I was prepared for the great diversity of opinion expressed by persons living in the same city or county as to the relative abundance of the several species reported. The value of any individual's statement must always be determined by the amount of time given to the study of the birds, and the time of day and of the year when the study pursued. The field covered is also an important element. The value which the person gives to the terms 'abundant', 'common', etc., is of minor importance unless fine distinctions are to be made.

A careful study of the reports received makes clear the fact that the greatest service which the 'Revised Catalog' could render to a large majority of those who have so kindly contributed to it would be more definite information about each species. Such definite information can be given for the most of our species, but upon some which are pretty well known while they are migrating, we need more light thrown. I refer particularly to some of the birds of prey,

the sparrows, warblers and vireos. The true status of many of these is not known.

A glance at the accompanying map of Ohio [a wall map used by the reader of this paper] will show from what counties reports have been received. You notice, at once, how inadequately the extreme western border is represented. It is here that we should look for several more of the western species whose ranges are gradually extending eastward. Notice what unknown possibilities lurk in that almost unexplored south-eastern quarter of the state. The mouths of the Scioto, Raccoon, Hocking and Muskingum rivers must be full of good things. The topography of that region makes it almost certain that we shall meet with surprises in our study of it. Fortunately, the extreme south-western corner is well worked by trained men. Here is where we might expect such rarities as Swainson's and Bachman's Warblers, Blue Grosbeak and Nonpareil, if anywhere. Notice that every county which touches Lake Erie is represented, while only three of the 14 counties bordering the Ohio river are represented. Clearly the southern border of our state needs attention. Dr. Wheaton and his collaborators seem to have known less about it than we do.

Dr. Wheaton's monumental catalog contains 298 species, two of which he expressly states are not entitled to a place, while two others, the two supposed summer shrikes, have since been reduced to a single species for this region, thus making his list stand at 295 authentic species. Two of these are introduced and six accidental in the state. There are others which may need to be placed in the list of accidental species. To these 295 species 20 have been added to date, while 14 others have been reported on insufficient authority to give them a place in the catalog proper. Four of these 315 species are introduced and eleven are accidental.

Three species — Prairie Hen, Carolina Paraquet and Skylark — have become extinct in the state since Dr. Wheaton prepared his catalog. At least three others are fast approaching extinction — Wild Turkey, Ruffed Grouse and

Passenger Pigeon. The last named species was supposed to be extinct, but recently a few have been recorded.

We thus have a catalog made up of four distinct categories, according to the present status of the several species. First, the native wild bird more or less regularly found within the state; second, species introduced by the agency of man; third, species whose known range lies well outside of the state but specimens of which have been taken; fourth, species which have become extinct in the state. Briefly, then: Native wild birds, Introduced, Accidental, Extinct. For the sake of clearness I would advocate following in the catalog this plan of grouping for the species. It would throw into relief our actual working list, emphasize the danger of the extinction of several species which it is very desirable to retain, and so furnish a basis for legislation; and it would more clearly illustrate the effect which topography has upon the movements and distribution of birds, because the wanderings of the species accounted accidental must clearly be due to some conditions imperfectly understood at present.

What, then, is involved in the preparation of such a catalog? Our first concern will be to determine to whom it is addressed. I assume that it is addressed to scientific men of all persuasions, and should therefore be strictly accurate scientifically. Also, that it is addressed to the agriculturalist and horticulturalist of both high and low degree, and to the forester, and that it should therefore contain information relating to the economic relations of the birds, particularly the food habits. And finally, that it is addressed to the general public, which includes the casual bird student, the teacher and all who find pleasure in the living bird, and that therefore it should be written in plain English.

The first and most obvious need of a revision is to bring the nomenclature up to date. Of the 298 species on Dr. Wheaton's list the names of 165, or more than half, have been changed, and the classification has been turned the other end to. The second reason for revising the catalog

is to add to the list the 20 species recorded since the old one was published, and to make the corrections necessary. The third reason, and to my mind the most important one, is to determine the present status of each species in the state, drawing comparisons with the conditions in Dr. Wheaton's time, on the one hand, and furnishing a basis for future comparisons on the other. During the 23 years since Dr. Wheaton's catalog was published there have been great changes in the physical features of the state, more in some regions, less in others, which must have produced marked changes in the fauna of the state. Dr. Wheaton's work was evidently so carefully done that we need have no hesitancy in accepting his statement of facts. It is only by such comparisons that we shall arrive at any accurate conclusions as to what effect our present methods of dealing with natural objects, and birds in particular, is producing. We are not at liberty and it is not safe to generalize about this. It is of too vital importance.

We already know enough about the most of our birds to draw accurate comparisons, but there are some about which we need more information. And of course, these few are among the most important species considered with reference to the comparison. I think that the work necessary in order to complete our information could be done in a single season by four trained ornithologists working in separate regions. Even one could accomplish a great deal during the first half of the coming summer. I am almost ready to give the assurance therefore, that the 'Revised Catalog' will be ready for the printer before the next winter meeting of the Academy.

Oberlin, Ohio.

NEW FOSSIL PLANTS FROM THE CARBONIFEROUS AND DEVONIAN.

H. HERZER.

Pterophycus plicatus, gen. nov.

(Fig. 1. Reduced one-half.)

The large leaf of this fucoid is only partly preserved, but enough of it to identify its character. It begins with a broad curved attachment; further up folds are contracted, especially three of them originating from a node and

FIG. 1. *Pterophycus plicatus*.

slowly diverging from each other, thickening progressively into rib-like supports of the frond. A broader ray with twin-nodes about 4 inches up constitutes one margin to the right, while at the same height on the mid-ray another

smaller and a larger node on the outer ray or fold can be seen. The upper end and probably a broad part of the side is wanting. The plication of this fucoid reminds one of the wing of a bird or fin of a fish.

Carboniferous sandstone. Marietta, Ohio.

Lianophycus polyfrons, gen. nov.

(Plate I. Reduced one-half.)

The simulation in life we find both in the present world and in the ancient, in living forms and in extinct forms; in the water and on the land. Thus in *Lianophycus polyfrons* we have a form from the ancient carboniferous ocean, that did its mission, like the *Lianos* as climbing plants in the forests of South America. I therefore created this Genus. This plant we find in twisted stems, some of them very delicate, reaching over from more robust seaweeds to others and climbing about and having hold wherever possible to sustain itself with its numerous fronds, and embellish a marine forest. The many dark brown spots overlapping each other in a squamous way, I could not but think that they have been marine foliage, because all the fucoid stems on that slab are of the same brown color, while the sandstone slab, on which I have it, is of a light ash-gray. The fronds were small but multitudinous, and growing in agglomerated bunches. — Carboniferous Sandstone. Harmer Hill, Marietta, Ohio.

Protopteris Kellermaniana, sp. nov.

(Plate II. Reduced one-half.)

Lower part of a stem one foot long, little compressed, $2\frac{1}{2}$ inches thick, spreading at the base to $4\frac{1}{2}$ inches, from which extend vertically numerous uniform roots 4 inches in length. The stem is pretty much scaled and exposing the inner vascular bundles running parallel through the stem, circularly arranged, the outer ones thin elongate, the inner punctate. Cells subcircular consisting of long fibrous

structure. Of interest also are two superimposed petioles extending out 2 inches from the middle of the stem. Found in a cherry nodule. In the same locality I found *Caulopteris antiqua* and *C. perigrina* described by Dr. Newberry in 1871. Named in honor of Prof. W. A. Kellerman, occupying the chair of Botany in the Ohio State University. —Corniferous Limestone, Delaware, Ohio.

Stemmatopteris distans, *sp. nov.*

(Fig. 2. Reduced one-half).

The upper extremity of a trunk, $6\frac{1}{2}$ inches of equal length and width and 1 inch thickness as indicated by the transverse section. It is rounding up cupulo-like and the sharp edges show the terminations of vascular fascicles constituting the structure of the plant, which seems compressed; but the fascicles are of the form as in *Psaronius vermicularis*. All look compressed and still the inner bundles seem undisturbed. The transverse section shows also the pithy center elongated with the long curved fascicles around which the outer fascicles group. One side of this plant presents three large distinct scars of a *Stemmatopteris*, 2 inches in length and one inch wide and about two inches apart. — Coal Measures, Athens Co., Ohio.

Psaronius vermiculus, *sp. nov.*

(Plate III.)

Trunk 2 feet 6 inches high, 1 foot in diameter, at the base 1 foot 7 inches wide; outer markings roughly longitudinally wrinkled with occasional rugose elevations running out at the spreading base like promontories of roots on trees. The lower surface of the perfect root-stock is a straight truncate level, crossed with grooves and rugose elevations; no trace of any roots or outrunners can be detected. Another specimen of almost that size and more silicified, is characterized at its inferior part in the same manner. The truncate superior of our specimen is flattened and not well

enough preserved to show the crater-like cup and in polishing the axis or pithy part was found to be very excentrically at one end and altogether marginal, $1\frac{1}{2}$ inch in diameter and very roughly polygonal. It has the common woody flexious clavate bundles with interstinct circular pithy cells.



FIG. 2. *Stenmatopteris distans*.

The rest of the trunk is made up of thin or narrow slender vermicular fascicles running parallel through the trunk; they are transversely 1-4 inch long and longer and 1-16 inch thick, crowding each other and pressing like an army of maggots toward the common axis, getting smaller, shorter and circular near the pithy center. A part of this species

I found at Wheeling, W. Va. 400 feet above the great Pittsburg coal vein, while our specimen was found in the Coal Measures, Athens Co., Ohio.

Earliest Fungi.

The specimen below published previously in American Geologist.

Incolaria securiformis. Herz.

(Fig. 3. Reduced one-half.)

A fossil-fungus of early times existing under the bark of *Sigillaria*, sending forth rounded overlapping mycelia. Lesquereux describes one also from under the bark of *Sigillaria*, found in the shale of the Cannelton coal, giving it as *Rhizomorpha Sigillariæ*. The above specimen was



FIG. 3. *Incolaria securiformis.*

found in the limestone of Coal No. 4 at Zoar, Tuscarawas Co., Ohio.

The rounded overlapping mycelia are parted from each other by a layer of coal 1-16 of an inch thick, showing by new attempts of invasion under the bark, that the tree tried by overgrowing one mycelium to exclude a further intrusion, but about 15 mycelia succeeded to locate at the place.

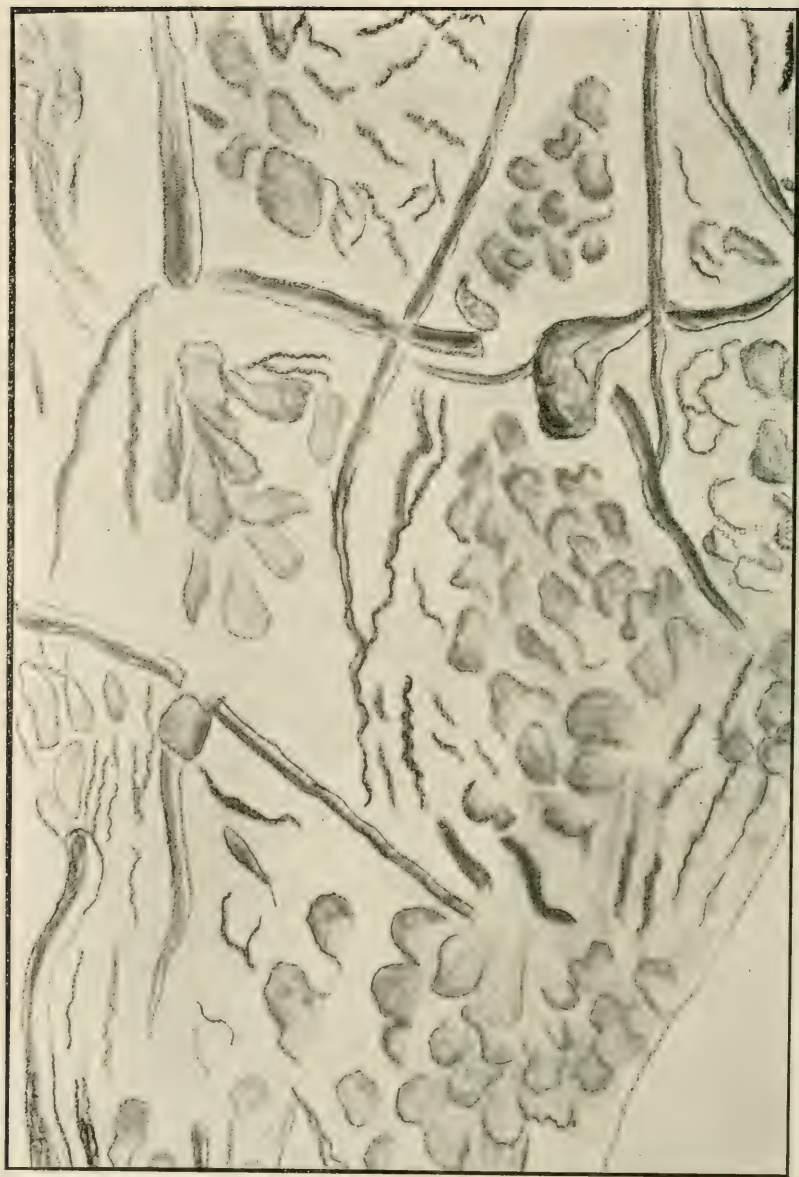


PLATE I. *Lianophycus polyfrons*.



PLATE II. *Protopteris Kellermaniana*.



PLATE III. *Psaronius vermiculus*.

NEW FOSSILS FROM THE CORNIFEROUS, HAMILTON, AND MEDINA SERIES.

II. HERZER.

Cystiphyllum discoideum, *sp. nov.*

(Plate IV, Fig. 1.)

A very flat discoid corallum, 3-16 inch high and 1 2-16 inch diameter; calyx superficial, smoothly floored and slightly depressed or concave, leaving a broad outer margin of 3-16 inch in width, well marked by about 90 stout radiating striæ indicating the regularity of its structure under surface with epitheca and marked by concentric growth of broad, flat rings, each one representing a superimposed floor; the edge of the uppermost showing indentations of striæ. Cysts rather small.

Corniferous limestone, Columbus, Ohio.

Cystiphyllum retrorsum, *sp. nov.*

(Plate IV. Fig. 2.)

Corallum simple, flat convex, $\frac{1}{4}$ inch high and 2 inches in diameter. Calyx reversed, smooth with two raised circular rings 5-16 inch apart, causing two marked zones on the surface, the outer zone with lamellular radiating rugæ 14 to one-half of an inch, indicating the cystoid arrangement. Cyst rather small.

Under surface comparatively concave, covered by an epitheca and marked by strong concentric raised rings of growth. Two of these specimens I found at Columbus, O., and two obliterated ones by silicification are from Ohio Falls.

Corniferous limestone, Columbus, O.

Cystiphyllum basalis, *sp. nov.*

(Plate V. Fig. 3. Slightly reduced).

The characteristic feature of this corallum is that it begins with a much broader basis than its upper skeleton,

which is erect-linear with thin murals and a broad first floor from which the calix ascends of equal diameter, one inch in width and one inch high. It looks like a minimized hollow tree-stump with root-spurs. Externally no epidermis can be observed but rudimentary cysts, as if a sarcoid texture had once coated it and suggests a *sea-anemone* fixed by means of a skeleton to a rock. The inner cysts are of medium size.

Corniferous limestone, Columbus, O.

Cystiphyllum perlamellosum, *sp. nov.*

(Plate V. Fig. 4. Slightly reduced.)

Corallum erect cylindrical, height probably 4-5 inch, only $2\frac{1}{2}$ inches of upper part preserved; diameter $1\frac{3}{4}$ inch., entirely denuded; depth of funnel-like calyx $1\frac{1}{4}$ inch. The lamellæ which characterize this *Cystiphyllum* give it the appearance of a coarse structured *Zaphrentis* interspersed with large elongated vesicles, one always filling the space between two lamellæ. The corallum is well defined into four principal divisions, each division contains eleven well marked lamellæ. The apertural gap at a width of $\frac{3}{4}$ inch shows no lamellæ, but new insertions of rows of vesicles and is slightly ventricose; the lateral gaps, also free of lamellæ and $\frac{1}{2}$ inch in width, show one-sided insertions, while the central gap with two parallel lamellæ, 1-3 wider apart than others, have much larger blisters. This is a most peculiar character among the *Cystiphyll*oid family.

Corniferous limestone, Ohio Falls.

Cystiphyllum scyphus, *sp. nov.*

(Plate V. Fig. 5. Slightly reduced.)

Corallum $3\frac{1}{2}$ inch high, beginning with a broad base on a shell and starting its calyx from the bottom, where it is narrow, then widening with the expansion of the walls which retain their equal thickness up to the margin. The calyx at its mouth has a diameter of $2\frac{1}{2}$ inches, marked interiorly by a number of diverging stout rugæ starting

from the bottom, others are inserted higher up. Cysts of moderate size. No. 1 lateral view; No. 2 seen from above. It is easily distinguished from all others.

Corniferous limestone, Ohio Falls.

Cystiphyllum prostratum, *sp. nov.*

(Plate V. Fig. 6. Slightly reduced.)

Corallum simple, turbinate at first, expanding regularly for an inch or so, then forming an offset, when an inch in diameter, either to produce another issue like the former, or bent suddenly at right angle to one side and assume in most cases a very flattened cylinder. The outcome from the first regular growth is very capricious. Its epitheca, well preserved, is wrinkled by fine concentric striae. Calyx very steep, nearly one inch deep; cysts large.

Corniferous limestone, Columbus, O.

Chonophyllum curvatum, *sp. nov.*

(Plate IV. Fig. 7.)

Corallum simple, transversely oval, strongly curved and halfway twisted to the right, with deep furrows and sharp concentric ridges and external markings of striae in the well preserved epitheca. Length of outer curvature 4 inches, rapidly expanding from the small pointed apex. Calyx oval, 2 inches long, $1\frac{3}{4}$ inches wide, broad margined with an insertion of an inner cup, narrowing the calyx to one inch in length and $\frac{3}{4}$ inch in width; depth $\frac{3}{4}$ inch; 40 cardinal lamellae meet around a raised center, which divide at a short distance multiplying the number into 80. The broad border of the calyx is obliterated by silicification.

Hamilton group, Crab Orchard, Ky.

Aulacophyllum enormis, *sp. nov.*

(Plate VI. Slightly reduced.)

Corallum turbinate, curved; epitheca finely striate, undulate, partly strictured, heavy wrinkled and partly denuded exposing a structure like a *Cyathophyllum*. Calyx $2\frac{1}{2}$ inches

deep, nearly 3 inches wide; lamellæ 120 very sharp and prominent, converging toward the fossette, which is sinking from the posterior side deeply over into the anterior wall, causing a narrow line through the center and leaving the sides of the calyx abruptly sloping. Very faintly the smaller two fossettes can be observed.

Corniferous limestone, Ohio Falls.

Chonophyllum cylindricum, *sp. nov.*

(Plate VII. Fig. 8.)

Corallum simple, erect, cylindrical, gradually tapering; length 3 in., lower extremity curved with several processes of attachment on its lower side. Exterior ornamented with epitheca marked with strong lamellar striation, small irregular constrictions, sharp marginate concentric wrinkles, partly exfoliated. Calyx 10-16 in. deep, $1\frac{1}{4}$ in. wide with 56 broad flattened lamellæ descending steeply, the cardinal ones occupying one third of the cup. A well developed smooth floor is presented, assuming an incline to the wall and more so to the fossette, which latter is not prominent. The exfoliation shows 13 invaginations of the calyx.

Corniferous limestone, Ohio Falls.

Aulacophyllum excenpricum, *sp. nov.*

(Plate VII. Fig. 10.)

Corallum simple, turbinate for the first in. and 1-4, then suddenly bending at almost right angle assuming a very flattened condition of more than one inch in width, rallying again constricted and geniculate into a cylindrical form with another inclination of departure to the interior. The whole length would be 4 in. and $\frac{1}{4}$. Calyx oval, $1\frac{1}{2}$ in. long, 1 in. across, with 80 lamellæ meeting in steep walls at a very narrow center, which begins a little posterial, the larger lamellæ converging toward the long and deep fossette. The whole form is denuded and looks like a contorted Corallum. A younger one exhibits the same tendency.

Corniferous limestone, Columbus, Ohio.

Hadrophyllum linguloideum, *sp. nov.*

(Plate VII. Fig. 11.)

Corallum free, exceedingly flat or short, ovid-linguloid, transverse diameter 1 3-16 in. and in direction of the large septal fossula over $1\frac{1}{2}$ in. long. Calicle superficial, posterior margin slightly raised, with a central fossula and two smaller ones, diverging from each other at almost right angle from the apex of the former and forming two acute angles on the calicle. Posteriorly it has 50 radiating septa, necessarily dividing toward an enlarged periphery. The interior part of the calicle has between each department of fossulæ 12 septa. This species is the largest in its genus. Shell-like it begins its growth most laterally and adding concentrically to the interior parts, so as to give the corallum with its perfect epitheca and rings of growth the appearance of a very large lingula being thick at the most lateral posterior apex and thinning out toward the front. —Corniferous Limestone, Ohio Falls.

Cyathophyllum capax, *sp. nov.*

(Plate IX. Fig. 12.)

Corallum simple, rapidly expanding, very ventricose to the anterior, slightly concave posteriorly; length 2 in.; calyx 2 in. across, laterally a little wider, posterior side oval and from side fossettes obliquely meeting the main fossette at right angle; depth $\frac{3}{4}$ in., walls thick, composed of 120 lamellæ, which are not prominent, causing a smoot interior; main lamellæ crossing the floor, which forms an imbossment, through which a deep broad fossette passes, leaving a spaciousness of the floor of $1\frac{1}{4}$ inch. —Corniferous Limestone, Columbus, Ohio.

Zaphrentis Neptun, *sp. nov.*

(Plate X. Fig. 13. Plate IX. Fig. 13.)

Corallum simple, erect, cylindrical, smooth with slight undulations and fine concentric rugæ in its epithelial coating.

Length 10 in., about two inches are of slender and tortuous beginning and are broken off. Its diameter is nearly 3 in. and retains it from 6 in. upward. Calyx of the same diameter, one inch and $\frac{1}{2}$ deep; lamellæ 180, the larger ones occupying 1-3 of the calyx and retain, although very short at the margin, a sharp ridge, while the floor is raised in the center into an elongate ridge-like mamae. No fossette is observable. — Corniferous Limestone, Ohio Falls.

Thecia Kentuckyensis, *sp. nov.*

(Plate IX. Fig. 14. Slightly reduced.)

Corallum massive, compound, somewhat pyriform, as large as a good handpiece, without epitheca. Orifices 9 to $\frac{1}{2}$ in., much larger than in any other species seen; walls stout, pentagonal; tubes marked on each side by three deep striæ, causing dentated margin like minute tents, being joined in this form from the next door orifice; mural pores large, not numerous. The specimen is silicified and has to some extent preserved its original structure. Spinal projections from walls somewhat flattened and short and quite numerous, filling the spaces of distinct diaphragms. — Hamilton Group, Crab Orchard, Ky.

Thecia Schriveri, *sp. nov.*

(Plate X. Fig. 15. Slightly reduced.)

Corallum ramose, preserved piece one inch and a half in length and 5 in. thick. Orifices large 9 to one inch; walls stout, sides of tubes fluted by three striæ, causing the dentated structures or orifices. Mural pores large and sparingly. Specimen poorly preserved by silicification, but still presenting its characteristic order. — Medina Sandstone, Cumberland, Md.

Favosites cystoides, *sp. nov.*

(Plate X. Fig. 16. Slightly reduced.)

Tubes in diameter 5 to $\frac{1}{2}$ inch, equal sized, sharply polygonal, thin walled; diaphragms flat and at irregular dis-

tances, sometimes much apart. Inner surface of tubes smooth, mural pores small, not numerous, spaces between diaphragms filled with large and small cysts of unsystematical arrangements, which gives this species a most peculiar character. No spines or squamæ can be detected; every effort of that kind organized into a labyrinthical spongy texture. External growth in convex masses. It is thus far known the only Favosites of such organization. — Corniferous Limestone, Ohio Falls.

Chonetes cinctatus, *sp. nov.*

(Fig. 1. Enlarged.)

Shell small, oval, gibbous; length two-thirds of its breadth; lateral margins curving in, so as to give development of two large ears, being quite mucronate, which terminate the hinge. Ventral valve quite convex without a mesial sinus in front; ears rounded and well projected;

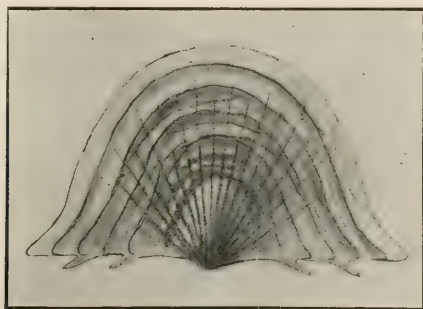


FIG. 1. *Chonetes cinctatus*.

area narrow; cardinal margin with two oblique spines on each side of the umbo. Surface ornamented with 12 stout rounded striæ, which gradually disappear in the banded structure of the shell, imbricating it in squamous manner up to a small area around the umbo. This imbrication is very irregular, more squamous and has been caused by the overlapping of the mantle of the animal, building its shell re-

versely, tiling from above. It is easy recognizable. Length of the individual two-eighths, breadth three-eighths inch. Corniferous limestone, Columbus, Ohio.

Gomphoceras isoteloides, sp. nov.

(Fig. 2a. Reduced one-half.)

Length of shell 6 inches, fusiform, transversely sub-oval; greatest diameter 2 inches at half length, from whence the shell tapers rapidly to either end, measuring at apex 3-8 inch and at anterior end $1\frac{1}{4}$ inch; the posterior half is slightly ventricose. The incrusting thin shell, nicely marked with fine concentric lines, covers entirely the air-chambers, as well as the chamber of habitation, and has the appearance of an "Indian relic."

Lower Corniferous limestone, U. Held. gr., Owens Station, Marion County, Ohio.

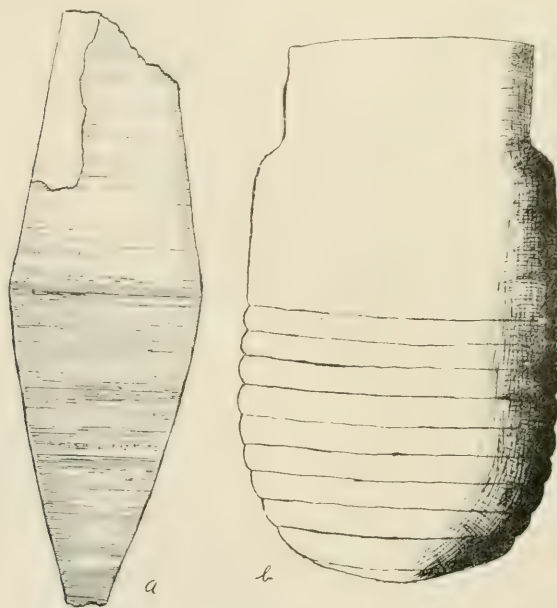


FIGURE 2.

(a) *Gomphoceras isoteloides*. (b) *Gomphoceras parallelum*.

Gomphoceras parallelum, *sp. nov.*

(Fig. 2b. Reduced one-half.)

Shell rather large, stout, transversly ovate; greatest diameter at the upper chamber; $3\frac{1}{2}$ inches broad, thickness $2\frac{1}{2}$ inches; length 6 inches. It developed with the three first chambers into its width, then running parallel up to the shoulders of habitation chamber, when the shell contracts on each side $\frac{1}{4}$ inch and keep up a parallel neck. Chambers 10, the four lowest tapering rapidly into a broad dome.

Habitation chamber large, 3 inches high, of which the neck occupies $1\frac{1}{4}$ inches.

Siphuncle not known, nor structure of shell.

Upper Corniferous limestone, Marion, Ohio.

Cyrtoceras crescens, *sp. nov.*

(Fig. 3. Reduced one-half.)

Shell large, nearly circular, of half moon shape: circular diameter $7\frac{3}{4}$ inches, greatest diameter of the tube at the 5th air chamber from above, and at the middle $4\frac{1}{2}$ inches. Habitation chamber triangular, the outer line sloping circularly over to the inner lip; width of base $4\frac{1}{4}$ inches. Air chambers 20; in another specimen the air chambers toward the apex are very shallow and presents 27 of them. In the specimen before us the apex is lost in the rock.

Siphuncle nor outer shellmarking could be observed. Associated with *Gyroceras Ohioensis*; *G. inelegans* in the blue limestone of the upper Corniferous group, Devonian. Marion, Ohio.

Cyrtoceras columbiense, *sp. nov.*

(Plate VIII. Slightly reduced.)

Shell-length $7\frac{1}{2}$ inches incomplete; central diameter $3\frac{1}{2}$ inches, exogastric curvature $\frac{3}{4}$ inch, section subcircular, chambers 3 to 1 inch ventrally. Habitation chamber length

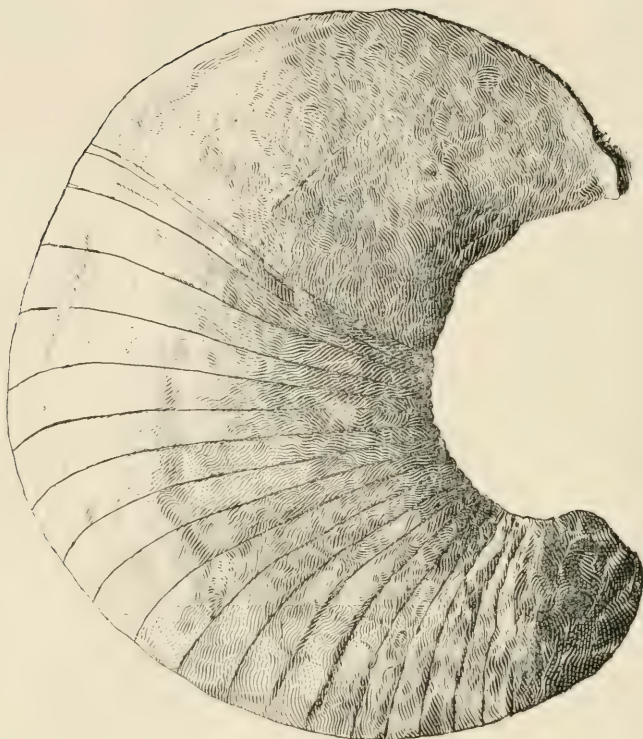


FIG. 3. *Cyrtoceras crescens*.

and width $3\frac{1}{2}$ inches. Air chambers 13, gradually deepening, 3 or 4 more made up the series.

Tube moderately enlarging and curving more rapid from apex to center.

Siphon near ventral side. Nothing of shell-marking or any other part observable. Its general contour is of the form of an armsleeve.

It is associated with *Gyroceras cyclops*, *G. columbiense*, *Orthoceras dagon*, *Gomphoceras impar*, *Gomph. eximium*, *Gomph. plenum*, etc., in the lower Corniferous limestone, U. Held. gr., Columbus, Ohio.

Arcuaceras Ohioense, gen. nov.

(Plate IX. Fig. 22. Slightly reduced.)

Shell large, abraded on both sides, very flat, only 11 chambers left, making a length of $3\frac{1}{2}$ inches. Habitation chamber wanting, volutions about three, increasing moderately in size, sharply edged, septa deeply concave, arching rapidly forward in sharp sinuses over the dorsum; transverse diameter must have been from 5 to 6 inches. A faint trace indicates the siphuncle running just under the sinuosity of the septa.

This sinuosity of chambers near the dorsum constitutes this fossil a new genus among cephalopoda.

Corniferous limestone, Columbus, Ohio.

Arcuaceras termicameratum, sp. nov.

(Plate X. Fig. 23. Reduced.)

Shell below medium size, discoidal, rounded over the dorsum apparently (although badly fractured); sides abraded; chambers very shallow and only nine preserved, which being very thin about the umbilicus, widen toward the sinuosity of the dorsum where the arch of chambers is high but gentle. The inner parts of chambers thin themselves together to a space of 3-8 inch, while the dorsum of the same number measures $1\frac{1}{4}$ inches. Umbilicus must have been thin; siphuncle not known; its diameter likely $2\frac{1}{2}$ inches.

Corniferous limestone, Columbus, O.

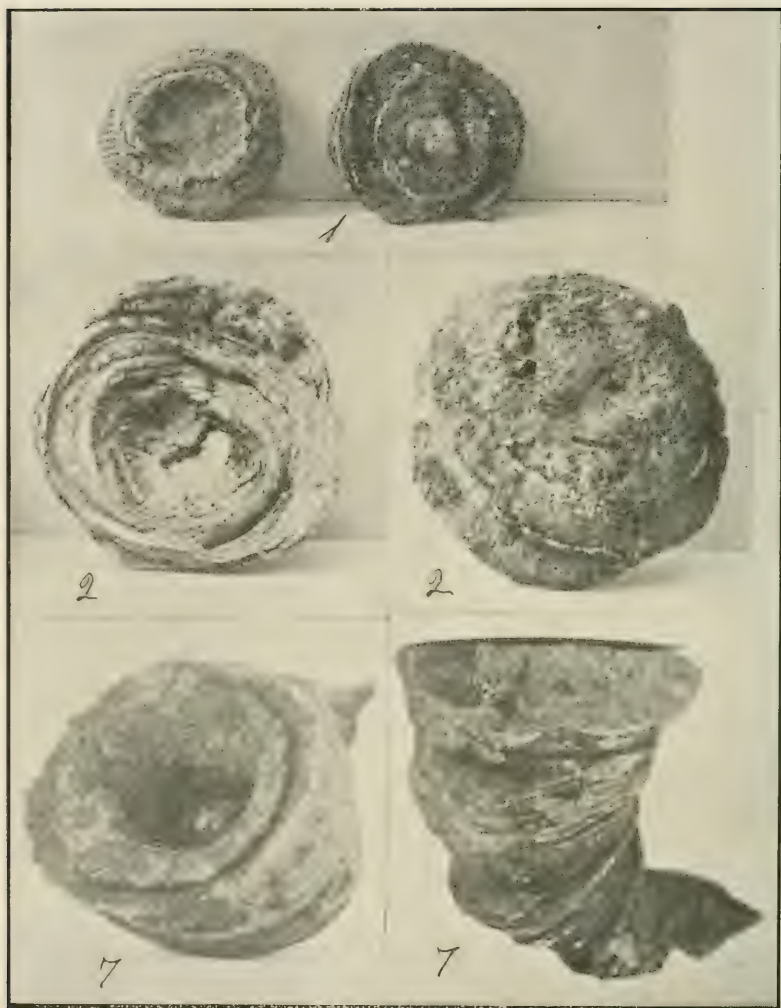


PLATE IV.

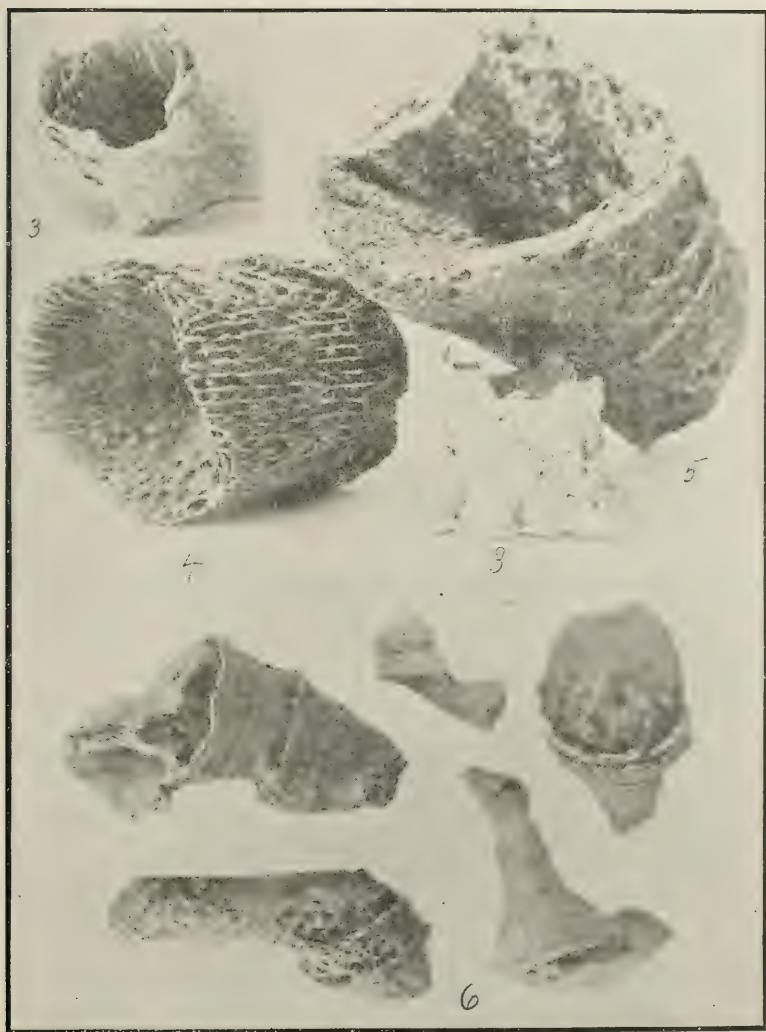


PLATE V.



PLATE VI. *Anlacophyllum enormis*.



PLATE VII.

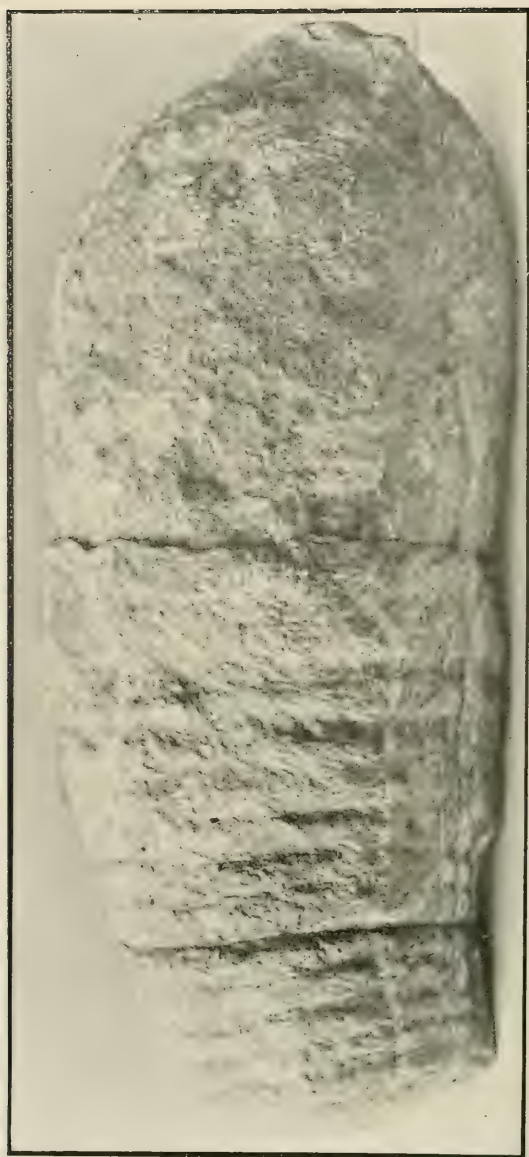


PLATE VIII. *Cyrtoceras columbiense*.

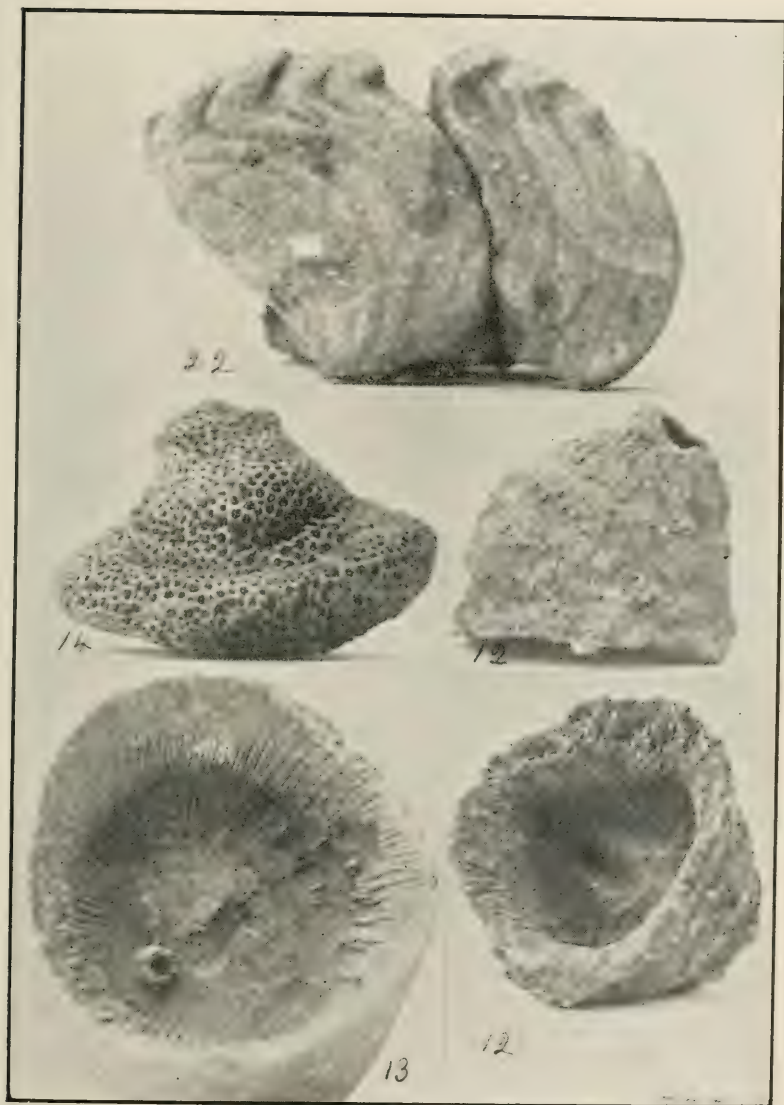


PLATE IX.

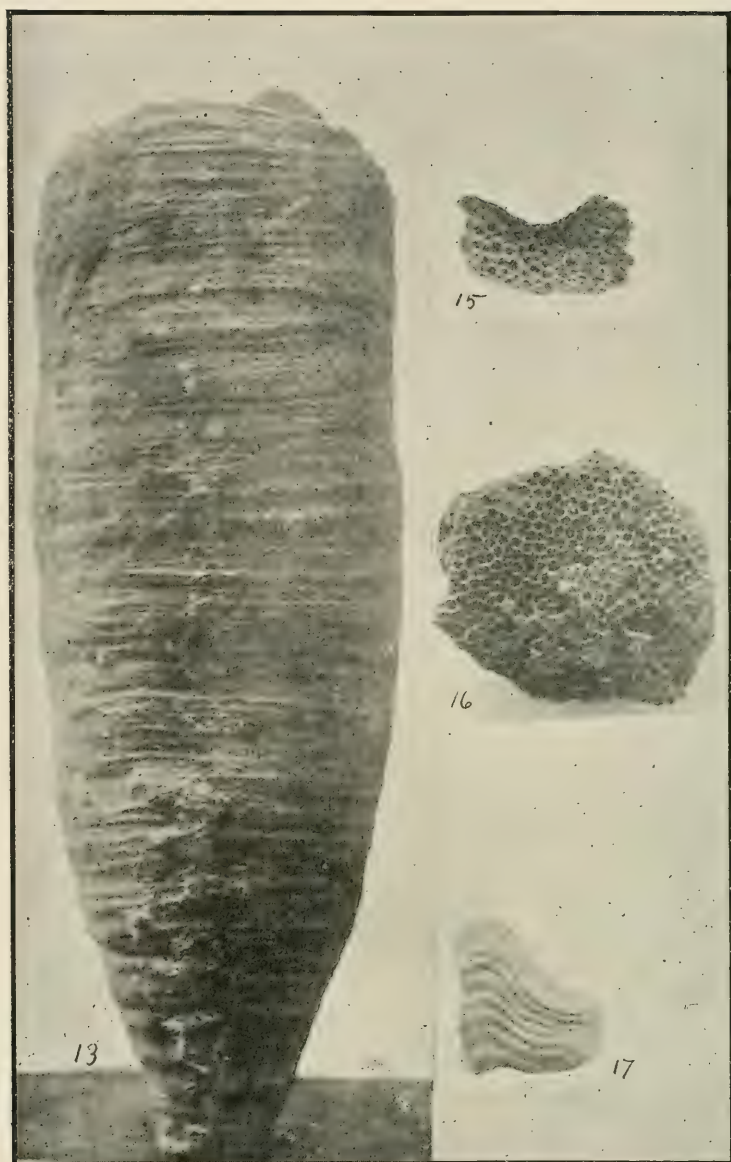


PLATE X.

PLANT ECOLOGY OF OHIO.

A GENERAL OUTLINE.

To contain a discussion of ecological principles illustrated by the aid of Ohio plants and an ecological treatment of the Ohio flora. With maps, charts and illustrations.

JOHN H. SCHIAFFNER AND FREDERICK J. TYLER.

INTRODUCTORY NOTE. — Since a topographic survey of the state is now in progress and Dr. Kellerman's catalogue of the higher plants of Ohio is nearly complete, the time was thought propitious to begin active work on the plant ecology. Although part of the work will be merely the compilation of facts already ascertained, nevertheless to accomplish the project now in mind will mean an enormous amount of investigation and exploration. It is therefore very desirable to get a union of forces, that the work may be pushed along all lines to a rapid completion. In order to accomplish this result we call upon all botanists in the state to assist in the work. The results will be published from time to time in the Ohio Naturalist, in the Annual Report of the Ohio State Academy of Science, or in any other suitable medium. We desire communication with any who wish to take up work along this line. After the ground has been covered in a general way by preliminary reports, there will be a substantial record from which an accurate ecology of the state may be written by those who may be interested in the subject at that time. With such a consummation in view we offer the following outline:

I. INTRODUCTION.

1. General survey of the irritable, responsive, and adaptative nature of plants.
2. Definition and scope of ecology.
3. Review of "Lehrbuch der oekologischen Pflanzengeographie." E. Warming.

4. Review of "Pflanzen-geographie auf Physiologischer Grundlage." A. F. W. Schimper.

5. Short notice of smaller papers and local ecological works in the United States and in Ohio.

6. A natural classification of Ohio plants. To be used to insure uniformity of expression in the different chapters and articles.

II. PHYSIOGRAPHY OF OHIO.

1. Geographical position, latitude and longitude, elevation.

2. Political map showing counties, railroads, and cities.

3. General topography.

4. Topographical map with 200 ft. contour lines.

5. Glaciated and non-glaciated regions.

6. Map showing the glaciated region.

7. Lake and river systems.

a. Lake Erie region.

b. Ohio valley region.

c. Small rivers, creeks, canals, reservoirs, small lakes, ponds, and swamps.

d. Map of lake and river systems.

8. Sand dunes and fossil lake beaches.

9. Salt licks and salt springs.

III. GENERAL GEOLOGY OF THE STATE.

1. Geological formations exposed.

2. Geological map of the state.

3. Surface rock and soil, as shale, limestone, sandstone, clay, alluvium, glacial drift and boulders, sand, and humus.

4. Surface soil map.

IV. METEOROLOGY.

1. Humidity, rainfall, snow, hail, and sleet.

2. Precipitation tables.

3. Sunshine and cloudiness.

4. Sky tables.

5. Means and extremes of heat and cold.

6. Temperature tables.
7. Wind, storms, and electrical phenomena.
8. General character of the seasons.
9. Maps.
 - a. Precipitation maps.
 - b. Isotherm map, mean temperature.
 - c. Map showing extremes of cold.

V. GENERAL CHARACTER OF THE VEGETATION.

1. A general survey of the flora of the state.

VI. FORMS OF VEGETATION.

1. Woody plants.
 - a. Trees.
 - b. Shrubs.
 - c. Undershrubs and brambles.
 - d. Half-shrubs.
 - e. Lianas.
2. Herbs.
 - a. Perennials or pleiocyclic herbs.
 - b. Plants with a single flowering period; annuals, biennials, and plants which live longer than two years.
3. Geophilous plants.
 - a. Crownformers.
 - b. Rhizomes.
 - c. Corms.
 - d. Bulbs.
 - e. Sod formers and bunch grasses.
4. Water plants.
 - a. Floating, free and fixed.
 - b. Submerged, free and fixed.
 - c. Amphibious.
5. Phagophytes.
 - a. General definition and classification of phagophytes into, 1, mutualistic plants (mutualism); 2, slaveholders (helotism); 3, parasites (par-

- asitism) ; 4, carnivorous plants ; and 5, saprophytes (saprophytism).
- b. Mutualistic higher plants ; with mycorrhiza, with green foliage and without green foliage ; with root-tubercle bacteria.
 - c. Parasitic higher plants ; parasitic on stems, with green foliage leaves, without green foliage leaves. Parasitic on roots, with green foliage leaves, without green foliage leaves.
 - d. Carnivorous plants ; with bands of adhesive surface around the stem, with pitfalls — cups produced by perfoliate leaves and leaves with cups, with leaves containing tentacles which exhibit movements in the capture of prey, with leaves having bladders which act like traps for aquatic plants and animals.
 - e. Higher plants which are partly saprophytic.
 - f. Phagophytic archegoniates.
6. Succulents and herbaceous perennials not geophytes.
 7. Climbing and twining plants.
 8. Trailing and creeping plants.
 9. Mats.
 10. Carpets.
 11. Rosettes.
 12. Thallus plants.
 - a. Mosses, liverworts, and horned liverworts.
 - b. Foliaceous, fruticose and crustaceous lichens.
 - c. Fungi ; xylophilous, biophilous, sathrophilous, and hydrophilous.
 - d. Algæ ; unicellular and coenobioid and filamentous — free and fixed.

VII. SPECIAL ADAPTATIONS.

- I. Leaves.
 - a. Motile leaves.
 - b. Compass plants.
 - c. Protective coverings.
 - d. Dissected and compound leaves.

- e. Mosaic arrangements.
- f. Rain-shedding devices.
- g. Deciduous leaves.
- h. Leaves which cover their axillary buds.
- 2. Winter protection of buds.
- 3. Winter hydrophytic buds.
- 4. Selfpruning of woody plants.
- 5. Vegetative propagation; as in the Raspberry, Walking Fern, Willow twigs, and leaf propagation of Roripa.
- 6. Stems.
 - a. Heliotropic movements of stems.
 - b. Fasciation, plants in which it is most common, and probable cause.
 - c. Witches' brooms.
- 7. Roots.
 - a. Relation to soil and water.
 - b. Aerial roots.
 - c. Prop-roots.
 - d. Storage organs.
 - e. Root contraction.
- 8. Coloration.
 - a. Spring and Autumn coloration.
 - b. General coloration of leaves, stems, and roots.
 - c. Colors of flowers and fruits.
- 9. Closing of flowers during cloudy weather and at night.
- 10. Night-blooming plants.
- 11. Floral clock.
- 12. Plants with anemophilous and hydrophilous pollination.
- 13. Mechanical devices for throwing pollen and spores.
- 14. Seed distribution.
 - a. Mechanical devices for throwing seeds, as in Acnida, Impatiens, and Hamamelis.
 - b. Distribution by water.
 - c. Distribution by wind; wings, plumes, pappus, tumbleweeds, distribution over ice.

15. Special adaptations to prevent injury from cold ; as in geotropic curvature of Fall rosettes, *Opuntia* joints, Juniper leaves, etc.

16. Plants with evergreen leaves, as *Gaultheria*, *Arbutus*, Pines, etc.

17. Shade-loving plants.

VIII. ECOLOGICAL RELATIONS OF ANIMALS AND PLANTS.

1. Effect of browsing animals, and injury caused by tramping. Thorns, prickles, cutting edges, irritating or poisonous sap.

2. Animal aid in the dispersal and planting of seeds and spores ; as Gophers and artichokes, squirrels and nuts.

3. Insect galls and other malformations due to animals.

4. Ants as fungus cultivators and farmers.

5. Plants which furnish homes and food to ant protectors.

6. Extra-floral nectaries.

7. Ornithophilous and entomophilous flowers.

8. Ohio flowers with odor.

9. Mutualistic associations ; as the green hydra, green fresh-water sponge, etc.

IX. ECOLOGICAL CHARACTERS OF THE NATURAL ORDERS AND FAMILIES FOUND IN OHIO.

1. A brief statement as to the abundance of species and individuals of each group and its local distribution, together with a general ecological characterization.

X. EBB AND FLOW OF VEGETATION DURING THE YEAR.

1. The progression of the development, blooming, and fruiting of plants through the seasons.

2. Chart showing character and abundance of flowers for the twelve months of the year.

3. The main periods for the blooming of characteristic families.

XI. THE PLANT SOCIETIES.

1. Hydrophyte societies.
 - a. Plankton.
 - b. Societies of the lake shore, ponds, streams, and canals; as the pondweed societies, the pond-lily society, etc.
 - c. Uliginous societies.
 - d. Marsh and swamp societies; as reed-grass-rush society, sphagnum swamp, swamp thicket, tamarack forest, etc.
 - e. Wet meadow societies; as sedge-meadow society, etc.
 - f. Sandbar societies.
 - g. Belt or zonal arrangement of hydrophyte societies.
2. Mesophyte societies.
 - a. The forest societies, pure and mixed, dicotyledonous and coniferous.
 - b. Thicket societies; underbrush and bramble.
 - c. Vertical strata in the forests.
 - d. Natural meadow and prairie societies.
 - e. Pasture-land societies.
 - f. Railway, roadside, waste field, and city lot societies.
 - g. Culture societies.
3. Xerophyte societies.
 - a. Sand dune and sand ridge societies.
 - b. Plants of rocky bluffs, hills, and high ridges.
 - c. Rock and dry wood societies.
4. Halophyte societies.
 - a. Salt lick and salt spring plants.
 - b. General consideration of the partial halophytes of the state.

XII. PLANT REGIONS OF THE STATE.

1. Determination of the extent of distinct plant regions and their boundaries.

2. Species peculiar and characteristic of the different regions.
3. Societies characteristic of the regions.
4. Conditions and factors which produce the plant regions determined.
5. Map of the state showing boundaries of the plant regions and districts.

XIII. LOCALITIES AND DISTRICTS OF SPECIAL INTEREST.

1. General character of the vegetation of the counties.
2. Investigations on special districts as Big Spring Prairie, Licking Reservoir, Cedar Swamp, Cedar Point, Sandusky bay, etc.

XIV. PLANT WANDERINGS AND MIGRATIONS.

1. Sources of the Ohio flora in time and space. Influence of the glacial epoch.
2. Immigrants and waifs.
3. Naturalized plants.
4. Native plants disappearing.

XV. GENETIC DEVELOPMENT OF PLANT SOCIETIES.

1. The development of societies in relation to the physiographic changes in time, including the birth, life, and death of plant societies.
2. The conflict or struggle between plant societies.
3. Transformations due to the changed physiography and land surface produced by man.

PRELIMINARY LIST OF TAMARACK BOGS IN OHIO.

A. D. SELBY.

The tamarack bogs, or as some have called them, the Canadian bogs of Ohio are, according to present knowledge, limited to possibly twelve counties of northeastern Ohio and possibly four counties of extreme northwestern Ohio. The northeast counties include Ashtabula, Trumbull, Geauga, Portage, Wayne, Summit, Stark and Columbiana counties in which the locations of a portion of the swamps are recorded; for Lake, Cuyahoga and Medina counties where such bogs are likely to exist, no records are at hand.

For extreme northwestern Ohio three or four bogs are on record in Williams and Defiance counties, while Fulton, Henry and perhaps two more adjacent counties may supply records to extend the list. I am fully aware that the present list can scarcely include half the known tamarack bogs of the counties in which such are listed. This imperfect knowledge is in part attributable to my disappointment in making the investigation of the plants of the tamarack bogs of Ohio for which the trustees of the Academy made a grant last spring. The first young man who proposed to assist, later went on a trip to Europe while the second was called to a position outside the state before he had fairly begun. The season however was rather unfavorable for bog work owing to the high water levels, and quite likely even better work may be accomplished another season — at least it is so hoped at present.

LIST OF BOGS CONTAINING TAMARACKS LOCATED IN NORTHEASTERN OHIO.

<i>County.</i>	<i>Name and Location.</i>	<i>Informant.</i>
Ashtabula	Bloomfield Bog, Orwell Tp., } extends across Co. line. . . . {	A. D. Selby. E. V. Louth.
Trumbull	Bloomfield Bog.	E. V. Louth.
Mahoning	Bog, eastern part?	
Columbiana . . .	Bog, Unity Tp.	I. N. Keyser.
Gauga	Bog, Burton Tp.	J. R. Watson.

LIST OF BOGS CONTAINING TAMARACKS LOCATED IN NORTHEASTERN OHIO. — Continued.

<i>County.</i>	<i>Name and Location.</i>	<i>Informant.</i>
Geauga	Fowler's Mills	J. R. Watson.
	Bass Lake, Munson Tp.....	J. R. Watson.
	Bogs, Russell and Newberry Townships	J. R. Watson.
	Congress Lake	A. D. Selby.
Portage	Fritch's Pond.....	?
	Garrettsville, Nelson Tp?...	R. J. Webb.
	Irwin Lake?	
	Doubtless others	
Stark	Canton Bog, City Canton....	E. W. Vickers.
	Myers' Lake Bog, Canton and Plain Tps	A. D. Selby.
	Hartwell Bog, Lake Tp.....	A. D. Selby.
	Congress Lake Bog, Lake Tp.	A. D. Selby.
	Three other Bogs, Lake Tp.	A. D. Selby.
Summit	Copley Bog, Copley Tp., about White Pond.....	A. D. Selby.
	Turkey Foot Bog.....	A. D. Selby.
	Long Lake Bog.....	A. D. Selby.
	East of Silver Lake.....	W. A. Kellerman.
	(Must be others).....	
Wayne	Fox Lake Bog, Baughman Tp	A. D. Selby.

Herein Geauga, Portage, Summit and Stark counties appear to lead with most southerly bogs in Stark county. While there are cranberry bogs about the small lakes in Wayne, Holmes and Ashland counties there appear to be none containing tamarack between the meridian of Wooster and that of Toledo—that is further west than Wooster until the extreme northwestern portion of Ohio is reached.

SIMILAR BOGS IN NORTHWESTERN OHIO.

<i>County.</i>	<i>Name and Location.</i>	<i>Informant.</i>
Williams	Montpelier Bog, Superior Tp.	A. D. Selby.
	Bridgewater Bog, Bridge-water Tp.....	J. Thomas Murchison.
	Bog, St. Joseph Tp.....	W. A. Kellerman.
Defiance	Three Bogs, Milford Tp....	Chas. E. Slocum.

While it is well known that there are many swamps and bogs in Lorain, Erie, Logan, Champlain and Clark counties, as well as many others, so far as I have been able to learn none of these contain tamarack as an original floral constituent. We have characteristic trees, notably the *Arbor Vitæ* in some of these swamps, conspicuously so in the Cedar swamps reached from Bowlusville near the boundary of Champlain and Clark counties. I was assured that swamps exist in southern Logan county of the same "Cedar" character, but it was lacking in several that I visited.

How may we account for the absence of these bogs or this particular tree in the region from Wayne and Medina counties westward and northwestward to the Maumee river? Is it because of the underlying geological differences, or because of the direction of plant movement? Whatever the explanation, we need more facts concerning the conditions existing and the plant societies of both sorts of bogs. I am at present engaged on the tamarack bogs and will greatly appreciate any information supplied me on the occurrence, drainage channels, area and floral peculiarities of any such bogs known to any members of the Academy, or their friends.

I had hoped that our committee on cataloging streams, lakes and swamps would supply much valuable aid in locating the remainder of the tamarack bogs now existing and possibly these hopes are yet to be realized. Certainly the present state of our accessible knowledge is quite deficient.

While working in Williams county I kept seeking to find Spring Lake, which according to the large maps of the Geological Survey, should be near the boundary of Northwest and Florence townships, that county. Finally somebody said that Spring Lake is simply the name of a post-office — there is no body of water there.

In closing I beg again to request that you send me what information any of you can give me about the tamarack bogs in Ohio.

NEW PLANTS FOR THE OHIO CATALOG.

A. D. SELBY, WOOSTER, OHIO.

The following plants not heretofore recorded for Ohio are in the collections of the Experiment Station:

Armillaria bulbiger Schw. In leaves, Wooster, O., October 12, 1901. (A. D. Selby.)

Flammula lubrica Fr. In leaves, Wooster O., October 6, 1901. (A. D. Selby, Warren F. Selby.)

Flammula subfulva Ph. In wounded area of living maple, Wooster, O., October, 1901. (A. D. Selby.)

Hypholoma perplexum Pk. On Chestnut stump, Wooster, O., October 12, 1901. (A. D. Selby.)

Potentilla pumila Poir. Nelson township, Portage Co., June 16, 1901. (R. J. Webb, A. N. Rood.)

Acuan Illinoensis (Mx.) Kuntze. On river grade, New Richmond, O., July 24, 1901. (A. D. Selby.)

Lactuca virosa L. Common. Heretofore identified as *L. Scariola*. (A. D. Selby.)

REPORT FOR 1901 ON THE STATE HERBARIUM INCLUDING ADDITIONS TO THE STATE PLANT LIST.

W. A. KELLERMAN.

The additions to the State Herbarium since my last annual report was made have amounted to 2,585 mounted sheets. The persons named below are the collectors; opposite each name is the number of specimens contributed. Similar activity has continued during the collecting season just past and hence we may expect an equally large addition to be incorporated into the State Herbarium, an account of which will be included in the next annual report.

Aiken, Walter H.....	5	Louth, E. V.....	3
Barchhoff, Sarah	1	McFadden, L. H.....	1
Bonser, Thos	25	Mertz, H. N.....	1
Case, Mrs. Theano W....	216	Minor, C. A.....	9
Claassen, E	1	Moseley, E. L.....	1
Clayton, W. M.....	7	Nettleton, A. W.....	5
Copeland Lilian	1	Osburn, R. C.....	4
DeLong, G. W.....	1	Ricksecker, A. E.....	2
Derby, S. C.....	1	Riddle, Lumina Cotton..	19
Drushel, J. A.....	28	Rood, Almond N.....	3
Fullmer, E. L.....	36	Schaffner, Jno. H.....	1
Gould, D. T.....	2	Sharp, Mrs. K. D.....	152
Griggs, R. F.....	20	Shorten, J. W.....	1
Griggs, R. F. and Tyler, F. J	1	Shull, Geo. A.....	17
Hacker, Otto	16	Stockberger, W. W....	3
Hoops, H. W.....	2	Tangeman, Clara M....	6
Howard, Emma	1	Thomson, F. E.....	4
James, J. F.....	1	Tyler, F. J.....	59
Jaske, H	1	Tyler, F. J & Wyman, T. B	1
Jennings, Otto E.....	34	Vandervoort, J. S.....	5
Kellerman, W. A.....	1,432	Watson, J. R.....	3
Kellerman, W. A. & Mrs.	7	Webb, R. J.....	58
Kellerman, W. A. & Beat- tie, W. R.....	33	Weber, Sophia F.....	1
Kellerman, W. A. & Full- mer, E. L.....	11	Weisman, Laura A.....	1
Kellerman, W. A. & Griggs, R. F.....	18	Werner, W. C.....	1
Kellerman, W. A. & K. F.	88	Wetzstein, A	21
Kellerman, W. A. & K. F. and Beattie, W. R....	6	Whipple, Frank	8
Kellerman, W. A. & K. F. and Jones, Victor	37	Wicks, A. E.....	63
Kellerman, W. A. & Ty- ler, F. J.....	1	Wilcox, E. Mead.....	1
Keifer, R. J.....	1	Wilkinson, E	1
Krebs, Wm	2	Williamson, E. B.....	88
		Winkler, H. J	1
		Young, Rachel	4
		Young, W. W.....	1
		Total	2,585

The number of mounted sheets in the State Herbarium was 13,012; this addition of 2,585 therefore brings the number up to 15,597. The plants named in the following alphabetical list are not given in the Fourth State Catalogue nor in the additions reported to the Academy December, 1900 (published in the Ninth Annual Report, page 40.) They were reported in the Ohio Naturalist, 1: 121; 2: 157-179, and the place indicated, by prefixed numbers, where they should be inserted in the Fourth State Catalogue.

Acnida tamariscina prostrata Uline and Bray. Painesville, Lake Co. Otto Hacker.

Acuan illinoensis (Mx.) Kuntze. (*Desmanthus brachylobus* Benth.) Illinois Mimosa. New Richmond, Clermont Co. A. D. Selby.

Aira caryophyllea L. Silvery Hair-grass. Rarely escaped. Painesville, Lake Co. Otto Hacker.

Apera spica-venti (L.) Beauv. Silky Bent-grass. Wildstraw. Painesville, Lake Co. Otto Hacker.

Arnoseris minima (L.) Dumort. Lamb Succory. Painesville, Lake Co. Otto Hacker.

Asperugo procumbens L. German Madwort. Catchweed. Painesville, Lake Co. Otto Hacker.

Asperula hexaphylla All. *Asperula*. Escaped. Painesville, Lake Co. Otto Hacker.

Botrychium lunaria (L.) Sw. Moonwort. Painesville, Lake Co. Otto Hacker.

Camelina microcarpa Andr. Small-fruited False-flax. Painesville, Lake Co. Otto Hacker.

Chrysanthemum indicum Hortorum. Escaped. Adams Co. W. A. Kellerman.

Coronilla varia L. *Coronilla*, Axseed, Axwort. Painesville, Lake Co. Otto Hacker.

Crataegus polybracteata Ashe. Reported previously, but without locality. Franklin, Hocking, and Summit Counties. W. A. Kellerman.

Crataegus pruinosa Wendl. Logan Co. W. A. Kellerman.

Crataegus succulenta. Franklin, Fairfield, Knox, Belmont,

- Summit, Ottawa, Union, Ross, Carroll, Shelby and Lucas Counties. W. A. Kellerman.
- Crocus vernus* All. *Crocus*. Escaped. Painesville, Lake Co. Otto Hacker.
- Datura metel* L. Entire-leaf Thorn-apple. Escaped. Painesville, Lake Co. Otto Hacker.
- Dianthus barbatus* L. Sweet William. Escaped. Painesville. Otto Hacker.
- Euonymus europaeus* L. Spindle-tree. Escaped. Painesville, Lake Co. Otto Hacker.
- Diodia teres* Walt. Rough Button-weed. Painesville, Lake Co. Otto Hacker.
- Euonymus cuphosperma* (Englem). Boiss. Warty Spurge. Painesville, Lake Co. Otto Hacker.
- Festuca myuros* L. Rat's-tail Fescue-grass. Painesville Lake Co. Otto Hacker.
- Fumaria parviflora* Lam. Small Fumitory. Painesville, Lake Co. Otto Hacker.
- Gemmingia chinensis* (L.) Kuntze. Blackberry Lily. Escaped. Franklin Co. J. H. Schaffner.
- Helianthus kellermani* Britt. Columbus, Franklin Co. W. A. Kellerman.
- Hieracium pilosella* L. Mouse-ear Hawkweed. Painesville, Lake Co. Otto Hacker.
- Hordeum distichum* L. Two-rowed Barley. Rarely escaped. Painesville, Lake Co. Otto Hacker.
- Hordeum sativum* Jessen. Common Barley. Occasionally escaped.
- Hypochaeris glabra* L. Smooth Cat's-ear. Painesville, Lake Co. Otto Hacker.
- Kickxia spuria* (L.) Dumort. (*Elatinoides spuria* Wetzst.) Painesville, Lake Co. Otto Hacker.
- Kneiffia linearis* (Mx.) Spach. Narrow-leaf Sundrops. Painesville, Lake Co. Otto Hacker.
- Lactuca virosa* L. Strong-scented Lettuce. Confused with *L. scariola* according to Britton, being the commoner of

- the two species. (A. D. Selby, Meeting Ohio Academy of Science, November, 1901.)
- Lemna cyclostasa* (Ell.) Chev. (*L. valdiviana* Phil.) Valdivia Duckweed. Richmond, Lake Co. Otto Hacker.
- Limnorchis hyperborea* (L.) Rybd. (*Habenaria hyperborea* (L.) R. Br.) Canton. Mrs. Theano W. Case.
- Linnaea borealis* L. Twin-flower. Canton, Stark Co. Mrs. Theano W. Case.
- Lychnis vesicaria* L. *Lychnis*. Escaped. Painesville, Lake Co. Otto Hacker.
- Mentha longifolia* (L.) Huds. Horse Mint. Painesville, Lake Co. Otto Hacker.
- Myagrum perfoliatum* L. *Myagrum*. Painesville, Lake Co. Otto Hacker.
- Petunia violacea* Lindl. Occasionally escaped.
- Physalis francheti* Mast. Chinese Lantern Plant. Escaped. Painesville, Lake Co. D. W. Talcott
- Portulaca grandiflora* Hook. Garden Portulaca. Sun Plant. Escaped, roadsides. St. Marys, Auglaize Co. A. Wetzstein.
- Potentilla pumila* Poir. Dwarf Five-finger. Painesville, Lake Co. Otto Hacker.
- Prunus mahaleb* L. Mahaleb. Perfumed Cherry. Columbus, Franklin Co. W. A. Kellermann; Painesville, Lake Co. Otto Hacker.
- Quercus alexanderi* Britton. Alexander's Oak. "Ohio;" N. L. Britton, Manual of Flora, 336. This was formerly confused with, or included in *Q. acuminata*, and like the latter is not uncommon in Ohio.
- Rubus neglectus* Peck. Purple Wild Raspberry. Painesville, Lake Co. Otto Hacker.
- Rubus phoenicolasius* Maxim. Japan Wineberry. Escaped from cultivation; comes freely from seed, and propagates by tips. Painesville, Lake Co. Otto Hacker.
- Salvia lanceolata* Willd. Lance-leaf Sage. By roadside near Columbus. W. A. Kellerman.
- Scutellaria parvula ambigua* Fernald. "Ohio," Nuttall; Greene Co. E. L. Moseley; Montgomery Co. W. U.

- Young; Franklin Co. E. E. Bogue; Gallia Co. J. W. Davis.
- Scutellaria serrata* Andr. Showy skullcap. Rio Grande, Gallia Co. Ruth E. Brockett.
- Secale cereale* L. Rye. Occasionally escaped.
- Sisymbrium altissimum* L. Tall *Sisymbrium*. L. D. Stair in List of Railroad Weeds; Painesville, Lake Co. Otto Hacker.
- Solanum tuberosum* L. Potato. Escaped.
- Sorbus aucuparia* L. European Mountain Ash. Escaped. Painesville, Lake Co. Otto Hacker.
- Gorghum vulgare* Pers. Occasionally escaped.
- Spigelia marylandica* L. Indian Pink or Carolina Pink. Fl. M. V., A. P. Morgan; North Madison, Lake Co. D. W. Talcott.
- Tanacetum vulgare crispum* DC. Tansy. Painesville, Lake Co. Otto Hacker.
- Teucrium occidentale* Gr. Hairy Germander. "Ohio," Riddell, 1834 (Bull. Torr. Club, 28: 170); Reservoir Park, Perry Co. W. A. Kellerman.
- Trifolium dubium* Sibth. Least Hop-Clover. Painesville, Lake Co. Otto Hacker.
- Urtica urens* L. Small Nettle. Painesville, Lake Co. Otto Hacker.
- Valeriana officinalis* L. Garden Valerian. Escaped. Painesville, Lake Co. Otto Hacker.
- Viburnum lantana* L. Wayfaring Tree. Escaped. Painesville, Lake Co. Otto Hacker.
- Viburnum molle* Mx. Soft-leaf Arrow-wood. Scioto county, W. A. Kellerman.
- Vicia augustifolia* Roth. Smaller Common Vetch. Painesville, Lake Co. Otto Hacker.
- Viola odorata* L. English or Sweet Violet. Escaped. Painesville, Lake Co. Otto Hacker.

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SPECIAL PAPERS, No. 5

Tabanidae of Ohio

WITH A CATALOGUE AND BIBLIO-
GRAPHY OF THE SPECIES FROM
AMERICA NORTH OF MEXICO

JAMES S. HINE,

Ohio State University

===== COLUMBUS, OHIO =====

1903

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JAMES S. HINE

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NOTE.

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WM. R. LAZENBY,

F. M. WEBSTER,

JOHN H. SCHAFFNER,

Trustees.

TABANIDÆ OF OHIO.

WITH A CATALOGUE AND BIBLIOGRAPHY OF THE SPECIES
FROM AMERICA, NORTH OF MEXICO.

INTRODUCTION.

With Osten Sacken's admirable "Prodrome of a Monograph of the Tabanidæ of the United States," most of the species of the family from the eastern part of our country may be identified readily. And with Williston's paper in the tenth volume of the Kansas Academy of Sciences most of our species not included in the above contribution are fully characterized. Hart's paper in the fourth volume of the Bulletin of the Illinois State Laboratory of Natural History is also useful in separating the various stages of the genera *Tabanus* and *Chrysops*, and is an important contribution to the life histories of a number of species of these two genera. The economic position occupied by the family is admirably treated in Osborn's paper on "Insects Affecting Domestic Animals," in Bulletin number five, new series, of the United States Division of Entomology. Other important contributions have appeared from time to time, but a thorough acquaintance with all this literature will not always give the student of the group the information he desires regarding points which come up in connection with many of the species of our fauna.

It is my intention in this paper to give some of the results of observations on habits taken during a somewhat extended study of members of the family, and follow with a systematic treatise of the forms known to occur within the bounds of the state of Ohio. At some future time, when the necessary material has accumulated it is the intention to give a full treatise of all the forms known to occur in North America.

The following have aided me up to the present time, in submitting material for study:

The United States National Museum; The Museum of Comparative Zoology; F. L. Harvey; Charles Dury; H. A. Gossard; C. P. Whitney; E. D. Ball; E. B. Williamson; J. C. Bridwell; Miss S. E. Harris; Chas. W. Johnson; C. C. Deam; Iowa State College; C. S. Brimley; R. C. Osburn; R. V. Harvey; E. J. Osler; F. F. Crevecoeur; Carnegie Museum; University of Kansas; H. S. Parish; R. E. Kunzé; J. T. Lloyd; Franklin Sherman, Jr.; Charles Fuclfs; Mrs. Anna T. Slossen.

I desire to study material from all parts of North America and offer to name specimens for anyone who will send them in; asking nothing for the naming except such specimens as the sender himself is pleased to donate.

It is the desire to make this paper plain enough to be easily understood, but the student must understand that it is necessary to have perfect specimens in order to be sure of his results in all cases. Many of the characters used in determining species in this family are easily damaged, consequently in collecting and pinning great care should be exercised.

EGGS AND EGG-LAYING.

All the species of the family I have observed ovipositing, place their eggs on some object that projects from and overhangs the water or that stands in wet and marshy places.

All of the *Chrysops* whose egg laying habits I know and many species of *Tabanus* place their eggs over water while other species of *Tabanus* oviposit on plants standing in wet ground. Some species are very precise in placing their eggs. Thus *T. stygius*, which is a very common species at Sandusky, follows the interesting habit of ovipositing on the upper surface of the leaves of *Sagittaria* just above the point where the petiole meets the expanded part of the leaf.

So closely is this habit followed that a hundred masses of eggs are found thus located to one placed otherwise. A few masses were observed on *Nymphæ* leaves but located exactly as when placed on *Sagittaria*. Only a very few masses were observed not placed in exactly the same position in reference to the leaves on which they were found.

In a certain marshy place where I have seen, in different years, numerous masses of eggs of *T. atratus* I noticed that these masses were nearly always found on the same species of *Scirpus* and situated very much alike in the great majority of cases.

I have watched several females of *C. callidus* during the entire process of oviposition which in this species usually occupies from twenty minutes to half an hour; during which time something like one to three hundred eggs are laid.

The female alights on the leaf head downward and begins by pushing the tip of her abdomen forward toward the sternum of the thorax and placing the protruding end of an egg against the leaf. This end sticks fast and she then moves the tip of her abdomen backward until its normal position is reached and the egg becomes free. By the same movement one or two eggs are then placed to one side of this one and two or three on the other side of it. The unfinished end is soon observed to be V-shaped; the female moving very gradually forward and placing the end

of her abdomen to one arm of the V and depositing eggs along down until the apex is reached, then changing the tip of her abdomen to the outer part of the other arm of the V and placing eggs along down to the apex on this side.

This process is kept up, the female changing regularly to the outer part of the opposite arm of the V each time the apex is reached. Between nine o'clock and noon seems to be the favorite time of day for oviposition with the various species of both *Chrysops* and *Tabanus*, and I have seldom been able to observe females ovipositing at other hours of the day.

The eggs when first laid are clear white but gradually get darker until they become permanently dark brown or black. Most of the eggs of *Chrysops* are deep black, and are placed in a single layer, but there are exceptions to this, for the egg of *C. celer* are never darker than brown, and are placed in at least three layers one upon the other.

The color of eggs in *Tabanus* is variable between brown and black, and so far as I have observed, are always placed in convex masses composed of layers one upon the other. In sections of eggs just laid no great amount of development is observable, and we therefore conclude that eggs are laid soon after they are fertilized. Temperature has its influence on the incubation period, and for this reason the length of time required for the hatching of Tabanid's eggs can not be said to be exactly so many hours. For instance, it took eggs of *Chrysops callidus* five or six days to hatch, and it required about a day longer in the case where eggs were kept in the shade the whole time, than in cases where the eggs were in the sun during the daytime.

Eggs of *Tabanus stygius* hatched in about seven days in each of the two or three trials I gave them. In all species observed all the eggs of a single mass hatch very near the same time, and the whole mass of wriggling larvæ go tumbling down into the water together. Once in the water they separate and sink to the muddy bottom, where they conceal themselves so securely that they are not usually seen again until they appear as adults. Sometimes there are a few eggs that are slow in hatching, and larvæ from these come out and drop to the water singly or in small groups.

LARVA AND PUPA.

The larvæ of the different species of this family are very much alike in appearance, except in size, consequently the full grown larvæ of the small species are hardly distinguishable from younger larvæ of the large species. They are tapering at each end, shining whitish in general color, and many of the larger specimens at least, are banded with dark brown or black.

The pupæ studied are dull yellowish in color, with an encircling row of spines or stiff hairs at the apical third of each abdominal segment. Characters for grouping the various species are located in the spiracles, and also in the denticles at the apex of the abdomen.

When the larva is first hatched a certain amount of 'yolk' is present in connection with the alimentary canal, and this furnishes it food for a time. The young larvæ of all the species studied in this stage possess the burrowing habit, and whatever soft material, plant or animal, they can reach they at once burrow into. Consequently little opportunity is offered under natural conditions for studying their habits and growth. The larvæ of many of the specimens probably remain in the water or in the mud very near the edge of the water throughout the existence of this stage for their pupæ come to the surface of the ground a few inches from the edge of the water just before the adults issue; and around fresh water ponds I have observed myriads of pupa skins of *Chrysops* with just the anterior ends projecting above the surface of the ground. There is a wide range of variation in the habits of larvæ of various species of *Tabanus*. Some are hatched in stagnant pools, some in ripples of streams and some in marshy ground. Some species live in water for a time and crawl out into dry ground; consequently one often finds *Tabanid* larvæ by digging in dry ground along the borders of ponds. Larvæ are easily reared if taken when nearly full grown, and appear to be as much at home in moist ground as in water. They eat small, soft-bodied invertebrates of many kinds, even their own species. We have kept them from fall until the following spring in small covered dishes filled with wet earth. Plenty of moisture was applied and earthworms from a greenhouse near by were given for food. In order to prevent one larva from eating another of its species, only one was kept in each dish. In a large number of trials only a few have died before reaching maturity.

Not much can be said regarding the length of time our species remain in the larval stage, but from circumstances one is led to believe that, in some cases at least, more than one year is consumed by this stage. At Sandusky, Ohio, in July, 1901, *Tabanus stygius* was very common, but in 1902, at the same place, only one or two specimens were seen. It may be that one can account for this difference on the ground of more than one year being required for the completion of the larval stage.

FIELD HABITS OF THE ADULTS.

The adults have many peculiar habits which the collector should know in order to become proficient in procuring specimens; and besides, some of these habits have an economic bearing also. The larval stage is passed in the water or at least in

wet places, and where the larva attains its full growth, the change to the pupa of course takes place; and as the pupa cannot transport itself it is evident that most adults issue in the vicinity of water or marshy ground. The only exception to this I have noted is when the larva or pupa has been carried to remote places by high water. It is not an uncommon thing to meet with teneral specimens of various species clinging to grasses, reeds and other plants growing in wet ground, waiting for their wings to harden. At such times males and females are theoretically equal in numbers, and although not always as distinctly marked as older specimens, they are nevertheless desirable. The sexes of Chrysops may be procured thus when other efforts come to naught.

As is well known only the females suck blood, and are therefore the only sex that molests stock. The males procure their food from plants and consequently are to be looked for on flowers and foliage. In an endeavor to satisfy myself whether or not the females visit flowers, I have taken from various blossoms the past summer no less than half a dozen females of different species, but not in a single instance have I taken the male from animals. The statement appears in print that females visit flowers for food when they are compelled to do so, but it is probable that their visits to flowers are not necessarily compulsory on their part. It seems more plausible that these visits are made at times from choice.

The females of Chrysops and some of the species of *Tabanus* come buzzing around the collector in numbers, and at such times may be taken easily with a net. The majority of the species of *Tabanus* in this region, however, are very active, and as they seldom alight on man for the purpose of sucking blood, not many are taken in the way just stated.

During the time the female is ovipositing the male is often resting near by on the foliage. At Georgesville, Ohio, June 4th, I observed *C. moechus* ovipositing on foliage overhanging a mill race; soon after specimens of the male sex were observed resting on the upper leaves of the same plant on which the females were ovipositing. In a few minutes collecting, a dozen or more specimens of each of the sexes were procured.

The sexes of many species of *Tabanus* often alight on the bare ground of paths or roads that run through the woods. At Cincinnati, June 10th, in company with Mr. Dury, we procured numbers of the sexes of different species resting on some furrows that were plowed around a woods to prevent the spread of fire. We also took the same species resting in paths and roads that ran through the woods. Some of these same species were

also taken from the low growing foliage in sunny places among the trees.

One of the best places I have ever found for taking the sexes of *Tabanus* and *Chrysops* is in the tall grass that skirts the marshes of Sandusky Bay. This grass is the *Phragmites* of botanists and grows to a great height. On July 6th, at Black Channel, when the wind was high, I went into a patch of this grass that was so dense that a net could not be used in it to advantage. Here *Tabanids* were abundant, and it was found that by approaching them very carefully, specimens could readily be picked off with the fingers. The male and female of *T. stygius*, *nivosus*, *C. moerens* and *brunneus* and the male of *T. affinis* and *bicolor* were taken in this way. This same grass furnished excellent collecting wherever found, but most material was procured when the wind was high. On the same date and near the same place the male of *C. brunneus* was taken from the flowers of the common spatter-dock, and this and *moerens* were procured by sweeping in the adjacent low-growing herbage.

Tabanus sulcifrons is an abundant species in northern Ohio during the latter part of July and all of August, and a fine opportunity for studying its mating habits has been presented. I have observed pairs of only two species of this genus in copulation, but so many pairs of *sulfifrons* have been noted in different years that it may be of value to record a few statements. All pairs have been observed before nine o'clock in the morning. On the 18th of last August I entered in my note book the following note: The day is clear and warm; *T. sulcifrons* abundant along the south side of a woods; between eight o'clock and half past eight several pairs observed copulating on the fence, and several pairs taken. The male in every instance clung to the edge of a rail, and the female with the legs and wings motionless and touching nothing hung suspended. The time occupied in making the observations on which this note is based was only a few minutes, considerably less than half an hour, and as I had been in the field where the species was abundant for some time previous and stayed for some minutes thereafter, and saw no pairs except as stated above, it would seem that the period for taking observations on the mating habits of *T. sulcifrons* is not a long one, and perhaps accounts for the scarcity of printed statements regarding this particular in our other species of the family. In an hour after these observations were taken hardly any specimens of either sex could be found in the vicinity.

The statement is in print regarding *Simulium*, which genus is composed of species having blood sucking females, that "since females once gorged with blood do not and can not return, copu-

lation and deposition of eggs must take place very soon after emergence from the water."* A careful examination was made of the females of the pairs taken in copulation to see if there was any indication of their having taken food previously. In several cases the alimentary tract was found to be well filled with blood. Two pairs were preserved in formalin, and when dissected the digestive system of the female contained a quantity of hardened blood, which when treated with glacial acetic acid yielded hæmin crystals.

Pangonia rasa, which is the only species of its genus so far taken in Ohio, has been found on flowers only. From what I have observed the female of this species has a special liking for flowers, for specimens have been taken from these when cattle were grazing near by at the time.

Goniops chrysocoma appears to be a common species in the state, but I have never seen it around stock. The females have been taken most often in woods resting on foliage of both herbaceous and woody plants. This sex may often be located by the noise made in vibrating the wings rapidly and striking the leaf at each downward stroke. Specimens have often been taken from dead leaves where the noise made is much louder than when the leaf is green. The males fly rapidly, and at intervals come to rest on low growing plants where they remain for a time; then they take wing again and are away so rapidly that the eye cannot follow them. Males at rest are easily approached, and this sex has been taken about as often as has the female.

Many, if not all, of the Tabanidæ in both sexes have the habit of coming to the water, and lowering themselves to its surface, dip several times in succession, and then fly away to alight on the bank or disappear from sight altogether. Writers have said that this is done for the purpose of drinking, and that at each dip a small quantity of water is taken up by the proboscis. This habit has an economic bearing which will be discussed on another page of this paper.

ANATOMY OF *TABANUS SULCIFRONS* MACQUART.

Tabanus sulcifrons, on account of the ease with which numerous specimens can be procured, has been chosen for the subject of a short study of anatomy.

In this study it has been the aim to use names which are in most common usage by the more prominent dipterologists, but sometimes a choice of one of the many names that have been used for a single region is a rather difficult matter.

* Report U. S. Commissioner of Agriculture for 1886, 509.

In order to study certain parts closely and locate their boundaries it is necessary to remove the vestiture which is most abundant on the face and sides of the thorax.

Head of female. The anterior part of the head is largely occupied by the compound eyes which are brown in color, and each is crossed transversely by two narrow, slightly curved, greenish or purplish bands.

The *antennae* are located on the lower middle of the head, and each is composed of three segments of which the third bears near its base an angular prominence which may be called the *upper angle* or *basal prominence* of the third antennal segment. Also this segment is compound, being composed of five annulations of which the basal one is longer than the other four taken together.

The *front* or *frons*, which is the region between the eyes above the antennae is nearly of the same width throughout. The space just above the antennae, the *subcallus*, is pollinose in this species. Above the subcallus is the *frontal callosity*, which is naked and shining, and occupies nearly the whole width of the lower part of the front. It is quadrangular in form, with a narrow elongate extension upward from its superior side.

The upper part of the front is the *vertex*, and the limit of the front above is the *vertical margin*. The *face* occupies the space bounded by the antennae, eyes and *oral margin*.

The middle part of the face beneath the antennae is swollen, while on each side is a less elevated area known as the *cheek*. The lower part of the face passes to the oral margin and the proboscis. The part of the proboscis which is visible in nature is largely *labium*.

The labium is grooved on the upper side, and into this groove the other mouth parts, with the exception of the palpi, are received. It may be likened to a sheath for the edges of the groove are extended and meet above, for at least a part of the length. Its distal part is furnished with an enlargement, the *labella*, which when the insect is taking food becomes a sucking disk.

The mouth parts which are received into the groove of the labium consist of six stylets, which are light brown in color and otherwise resemble one another. If these be separated from the labium, the *labrum* may be seen farthest forward and just behind it the smaller *hypopharynx*. Next in order passing backwards are the *mandibles* lying side by side while the *maxillae* the narrowest of the mouth parts lie posterior to the mandibles. Each maxilla has attached to its base a large *maxillary palp*, which is composed of a shorter basal, and a larger and longer distal joint. These maxillary palps in their natural position are very promi-

nent, the proximal joint projects forward so that the large distal segment is carried before all the other mouth parts.

The rear of the head is usually referred to simply as the *occiput*, near the middle of which the head is joined to the thorax, a narrow strip lying above this junction is sometimes referred to as the *nape* or *cervix*. The cervix in this species is quite obviously bounded by sutures.

Head of male. The head is larger and approaches nearer to hemispherical than in the female. The eyes are continuous for a long distance and thus the front is divided into two parts called the *vertical* and *frontal triangles*. The former is very small and is bounded above by the vertical margin and bears no *ocelli* or simple eyes in this species. The latter is limited below by the antennæ and includes the subcallus. Because of the increased size of the head the antennæ appear to have their union higher up.

The face in this sex is different than in the female. The sides or cheeks are about in the same plane with the surface of the eyes while the median part is much depressed. The mouth parts also differ; the mandibles are entirely lacking and some of the other parts are noticeably reduced. The second joint of the maxillary palp is smaller and shorter than in the female, and turns upward to lie against the face. The uppermost greenish band of the eye is abbreviated outwardly and just above it, next the frontal triangle, is the division between the lower area of small facets and the upper area of large facets of which the eye is composed. On the outer and upper margin of the eye the area of small facets is extended to where the eye meets the vertical triangle.

Thorax. The three primary divisions of the thorax are not easily separated, but the *mesothorax* comprises nearly all the space visible from above, including the posterior, somewhat triangular portion called the *scutellum*.

The *prothorax* is small but is easily located from the fact that it bears the anterior pair of legs. A small lobe of the prothorax, easily distinguished by being lighter in color, is closely applied to each anterior corner, or *humerus* of the mesothorax. Lying between the attachment of the anterior leg and the humerus are two small prominences and just posterior to these latter is the *anterior thoracic spiracle* which marks the beginning of a suture, the *dorso-pleural suture*, which passes backward through the attachment of the wings, and ends beneath the front edge of the scutellum.

The dorso-pleural suture marks the division between the superior and lateral parts of the mesothorax, known respectively

as *dorsum* and *pleura*; at the sides of the middle of the dorsum is a suture, furcate below and obsolete above, the *transverse suture*.

In Diptera it seems not to be definitely settled as regards the downward extension of the *pleura*, but "the inferior surface of the thorax between the legs" has received the name of *pectus*.

The *metathorax* is small and the *metanotum*, which is the part of it visible from above, may be seen beneath the scutellum, by viewing from behind.

Passing toward the *pectus* on each side we observe a prominence called the *lateral callosity* of the *metathorax*. Behind the lateral callosities are located the poisers or *halteres*, and just beneath them the *posterior thoracic spiracles*.

The prothorax bears a pair of legs, the mesothorax a pair of legs and the pair of wings, and the *metathorax* a pair of legs and a pair of *halteres*.

The legs are each composed of five sections; the *coxa* next the thorax, and following in succession the *trochanter*, *femur*, *tibia* and *tarsus*. Each tarsus contains five segments of which the last or fifth bears a pair of *claws*, a pair of pads or *pulvilli* beneath the claws, and between the *pulvilli* a single *empodium*, which is developed similar to the *pulvilli*. The prothoracic *coxæ* are slightly more than half as long as the femora of these legs, while the *coxæ* of the other legs are very much shorter.

There seems to be no notable difference between the legs of male and female except in the front feet where the male claws, *pulvilli* and *empodii* are much larger than the same parts in the female.

By taking a specimen of *Tabanus* with its wings spread and following the posterior border of a wing toward the body one finds toward the base an incision, the *axillary incision*, between which and the scutellum are three membranous lobes. These in order are called *alula*, *antitegula* and *tegula*.

The first, bordering the axillary incision, is considered as a part of the wing proper; but the other two called *tegulae* when taken together are usually considered as accessory. In closing the wing it is seen that the *antitegula* moves with the wing while the *tegula*, although joined with the *antitegula* is also securely joined with the thorax, remains practically stationary. When the wing is closed the *antitegula* fits over the *tegula* and nearly hides it from view. The *halteres* have their attachment beneath the *tegula*, therefore their basal parts are concealed, but the apical yellow knobs are always visible.

Wing. Plate II shows the regions and venation of a wing of *Tabanus stygius* Say, and reference to the drawing will make it easy to locate them.

Many species of *Tabanus* have the wings entirely transparent while others have dark areas which furnish distinctive characters. In *T. sulcifrons* dark markings are located at the bifurcation of the third vein and along the veins at the discal end of the discal cell; when markings are present on the wings of the various species of *Tabanus* it is more common to find them where the third vein branches and along the veins or parts of veins which are most nearly transverse. Exceptions to this may be seen by reference to *venustus* and *turbidus*.

Abdomen. The markings of the abdomen in this species consist of rather broad white triangles and white posterior margins on most of the segments. These markings are formed by the color and arrangement of the vestiture, which consists of hairs and dust or pollen. With a bristle brush the hair may be easily removed from a dry specimen, but on the same kind of a specimen the pollen is more persistent and therefore more readily removed by rubbing after it has been moistened.

When all the vestiture has been removed the abdomen is nearly a uniform brown all over and appears quite different than in a perfect specimen.

Seven segments are visible to the unaided eye. The circumference decreases from the second backward, and concealed by the seventh or smallest are what may be considered as three very much reduced additional segments, which are easily removed by the aid of a needle and which can only be differentiated satisfactorily by the use of a microscope or strong lense. These segments besides being smaller are much modified in both sexes. In the female from ventral view, is visible a sclerite, *infraanal plate*, which is interesting from a specific standpoint, and its form may be seen best by reference to Fig. 9, q. plate I.

The *claspers* of the male are borne by the eighth segment, each of these are composed of two joints, which are movable; therefore they appear different in different specimens as may be seen by reference to the figures, plate I, Figs. 6 and 10.

MALES COMPARED WITH FEMALES.

The males and females in the entire family are easily distinguished from the fact that the former sex has the eyes contiguous and the latter has the eyes plainly separated. In all the species studied the male has the proboscis longer and slenderer, and the front feet larger than in the female. The palpi in the female point downward and the second segment is carried in front of the proboscis, while in the male they often turn upward and the second segment is carried against the face.

Usually the males and females of the same species are easily associated, but in a number of species it is not an easy matter at least until they have been taken in the same locality in the field.

In Chrysops the apex of the wing beyond the cross-band is marked the same in both sexes even though the difference in coloration between the male and female is striking. This is noticeable in *C. moechus* in which the female is largely marked with yellowish while the male is entirely black. The base of the wings of the males of nearly all of the species of Chrysops have more black than do the females, and in some species like *celer* the female has the sides of the thorax densely clothed with yellow pile while the same parts in the male are less densely clothed with black pile giving the two sexes a very different appearance.

In the female of *Tabanus stygius* the dorsum of the thorax is clothed with white pollen, while in the male this is largely lacking, thus giving the sexes a very different appearance.

The sexes of *Goniops chrysocoma* are notably different in appearance, because of the fact that the whole body is black in the male and light yellowish in the female.

ARTIFICIAL REMEDIES.

Various species of the family are very annoying to stock, but although their biting habits have been known for years no generally practical remedies have been suggested for their control. Work horses may be protected by the use of fly-nets, and burlap blankets are often used on cattle and horses, but these blankets have their objectionable features, and it is doubtful if they come into general use in the near future. Kerosene emulsion, carbolic acid, fish oil and a variety of substances have been used, and beneficial results have been obtained from a number of them, but the benefits derived from a single application are of such short duration that to many their use is thought to be impracticable.

The most valuable results in destroying horse flies were obtained by Porchinski in Russia, and are described by Howard in a paper published in Bulletin number 20, new series, of the U. S. Division of Entomology. The method employed consists in applying kerosene to the surface of stagnant water for the purpose of coming in contact with the adults when they come to drink. It may be added from my own observations that the same application is of consequence in killing larvæ at the time they hatch and drop into the water. As the eggs of so many of our species are deposited over water and the larvæ drop down into the water when they hatch, I am of the opinion that more striking results may be obtained from the use of kerosene on the surface of stagnant water in destroying larvæ than in destroying adults.

NATURAL ENEMIES.

Some years ago Hart reared a hymenopterous parasite, *Panurus tabanivorus*, from the eggs of *T. atratus*. This appears to be a common parasite, and I have reared more than a hundred specimens from a single cluster of eggs.

It is very common to find clusters of eggs of both *Tabanus* and *Chrysops* more or less injured by being eaten into and some of the eggs destroyed. Various predaceous insects have been observed to be responsible for this condition of things.

Around ponds where *Tabanids* are issuing many specimens fall a prey to predaceous insects of different orders. *Tabanids* fresh from the pupa case are not active and require time for their wings to harden before they fly readily. I have observed two species of Hemiptera, *Linnobates marginatus* and *Phytocoris nubilis*, preying upon teneral adults of *Chrysops callidus*; and E. B. Williamson has sent in teneral specimens of *Chrysops vitatus* taken from *Mesothemis simplicicollis*, one of our commonest dragonflies. Robber flies of the family *Asilidæ*, which appear to have no choice of species when capturing their prey, have occasionally been captured with specimens of *Tabanus* in their possession.

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CATALOGUE OF TABANIDÆ FROM AMERICA NORTH OF MEXICO.

The following catalogue is presented for the purpose of giving the distribution, synonymy and bibliography of the species from America north of Mexico. A few species not yet reported from north of the Mexican boundary are included, but southern species are added to our fauna from time to time and it is likely many others will be added from Mexico when extensive collections can be secured from our southern states.

The bibliography does not include all references but only such as are of value in characterizing or extending the range of the species given.

Names in italics are synonyms of the one in Roman above. There are many other synonymous names in the list but evidence at hand is not sufficient to locate them. The names that have been proposed for our species are brought together as a basis for future work. Many of the types of the older students of the family are not in existence at the present time, and it is likely that later students have sometimes redescribed their species under other names; so it is no small task to solve present problems in a satisfactory way.

There are a few names in older works given to species with habitat unknown: some of these names may have been given to specimens from this region. Such names, and a few others excluded for other reasons, are not given in the list which follows.

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- proclivis Osten Sacken. West. Dipt. 222, 1877. Ricardo, Ann. Mag. Nat. Hist. Ser. 7, VIII, 306. Habitat; Cal., Wash., Col., Oregon.
- atricornis* Bigot. Mem. Soc. Zool. Fr. V, 603, 1892.
- pudicus Osten Sacken. Prodrôme I, 381, 1875. Prodrôme II, 474. Williston, Tr. Ks. Acad. Sci. X, 134. Habitat; Mass., N. Y., N. J., N. C., Fla.
- sackeni Hine. Described in this paper. Habitat; Sandusky, Ohio.
- sepulchralis Kirby (not Fabricius). Fauna Bor. Am. Ins. 314, 1837. Osten Sacken, Catalogue 1878, 54.
- sequax Williston. Tr. Kas. Acad. Sci. X, 133, 1887. Habitat; Kansas.
- sordidus Osten Sacken. Prodrôme I, 376, 1875. Williston, Tr. Ks. Acad. Sci. X, 131. Ricardo, An. Mag. Nat. Hist. Ser. 7, VIII, 305. Habitat; White Mts., N. H., British Possessions.
- striatus Osten Sacken. Prodrôme I, 391, 1875. Habitat; Ill., D. C., N. J., Mexico, Ohio.
- vittatus* Bellardi (not Wiedeman). Sag. Ditt. Mess. I, 74, 1859.
- surdus Osten Sacken. West. Dipt. 223, 1887. Williston, Tr. Ks. Acad. Sc. X, 134. Habitat; California.
- univittatus Macquart. Dipt. Exot., suppl. 5, 36, 1855. Osten Sacken, Prodrôme I, 387. Habitat; Pa., N. C., La., Md., N. J., Ills., Ohio, Fla.
- (?) *fascipennis* Macquart. Hist. Nat. Dipt. I, 216, 1834. Walker, List I, 197, (var?). List V, 288.
- vittatus Wiedeman. Dipt. Exot. I, 106, 1821. Auss. zweifl. Ins. I, 200. Macquart, suppl. 5, 37. Osten Sacken, Prodrôme I, 390. Townsend, Tr. Am. Ent. Soc. XXII, 57. Ricardo, An. Mag. Nat. Hist. Ser. 7, VIII, 300. Habitat; Eastern North America, as far west as Kansas and Iowa.
- areolatus* Walker. List I, 197, 1848.
- lineatus* Jeannicke. Neue Dipt. Exot. 26, 1868.

PANGONIA Latreille.

Hist. Nat. des Crust. et des Ins. III, 1802.

- californica Bigot. Mem. Soc. Zool. Fr. V, 618, 1892. Habitat; Cal.
- dives Williston. Tr. Ks. Acad. Sci. X, 130, 1886. Habitat; California.
- fera Williston. Tr. Ks. Acad. Sci. X, 130, 1886. Habitat; Mt. Hood, Oregon.
- hera Osten Sacken. West. Dipt. 214, 1877. Habitat; San Francisco, Cal.
- incisa Wiedeman. Auss. zweifl. Ins. I, 90, 1828. Habitat; Ark., Col., N. M., Oklahoma.
- incisuralis* Say, Jr. Ac. Nat. Sc. Phil. III, 31, 1823; Compl. Writings, I, 75.
- isabellina Wiedeman. Auss. zweifl. Ins. I, 112, 1828. Osten Sacken, Catalogue 1878, 225, Habitat; North America.
- macroglossa Westwood. Lond. Edinb. Phil. Mag. 1835. Osten Sacken, Prodrôme I, 368, 1875. Habitat; Georgia.
- pigra Osten Sacken. Prodrôme I, 367, 1875. Habitat; N. Y., N. J., Ky., Fla.
- rasa Loew. Dipt. Am. sept. ind. pt. 8, no. 7, 1869. Osten Sacken, Prodrôme I, 366. Habitat; Ills., Wis., N. Y., Ky., Conn., Ohio.
- ruficornis Bigot. Mem. Soc. Zool. Fr. V, 615, 1892. Habitat; California.
- saussurei Bellardi. Saggio Ditt. Mess. I, 49, 1859. Habitat; Southern Arizona, Mexico.
- seminuda Coquillett, Jr. N. Y. Ene. Soc. X, 137, 1902. Habitat; Mexico.

- tranquilla* Osten Sacken. Prodrôme I, 367, 1875. Habitat; Penn., Mass., N. H., Canada.
velutina Bigot. Mem. Soc. Zool. Fr. V, 615, 1892. Habitat; California.

GONIOPS Aldrich.

Psyche VI, 236, 1892.

- chrysocoma* Osten Sacken. Prodrôme I, 368, 1875. Hine, Ent. News XI, 392. Aldrich, Ent. News XI, 531. Habitat; N. Y., N. J., Del., Pa., Ohio, Fla.
hippoboscoides Aldrich. Psyche VI, 236, 1892.

SILVIUS Meigen.

Syst. Besch. europ. zwei. Insecten III, 27, 1820.

- gigantulus* Loew. Dipt. Am. Sept. ind. pt. 10, no. 12, 1872. Osten Sacken, West. Dipt. 215; Catalogue 1878, 226. Habitat; Cal., Wash., B. C., N. M., Col.
trifolium Osten Sacken. Prodrôme I, 395, 1875.
pollinosus Williston. Tr. Conn. Ac. IV, 244, 1882; Tr. Ks. Ac. Sc. X, 131. Habitat; Kan., Col.
quadrivittatus Say, Jr. Ac. Phila. III, 33, 1823; Compl. Writ. II, 54. Wiedeman, Auss. zweifl. Ins. I, 200. Osten Sacken, Catalogue 1878, 226. Williston, Tr. Ks. Ac. Sc. X, 131. Habitat; Cal., Neb., N. M.

APATOLESTES Williston.

Entom. Americana I, 12, 1885.

- comastes* Williston. Entom. Amer. I, 12, 1885. Townsend, Tr. Ks. Ac. Sc. XIII, 134. Habitat; N. M., Cal.
eiseni Townsend. Pr. Cal. Ac. Sc., Ser. 2, IV, 596, 1895. Habitat; San Jose del Cabo, Lower California.

HÆMATOPOTA Meigen.

Illig. Magaz. II, 267, 1803.

- americana* Osten Sacken. Prodrôme I, 395, 1875. Habitat; Dakota, Mont., Col., Br. Col., Cal.
punctulata Macquart. Dipt. Exot. I, pt. 1, 163, 1838. Habitat; Carolina, Fla., N. J., R. I.

DIACHLORUS Osten Sacken.

Prodrôme II, 475, 1876.

- ferrugatus* Fabricius. Syst. Antl. 111, 1805. Wiedeman, Dipt. Exot. 1, 94; Auss. zweifl. Ins. 186. Walker, List I, 191; V, 148. Osten Sacken, Prodrôme I, 396; Biol. Cent. Am. I, 57. Habitat; Fla., Mexico.
americanus Palisot de Beauvois. Ins. Dipt. 222, tab. 3, fig. 6.
approximans Walker. List I, 198.
ataenia Macquart. Dipt. Exot. I, pt. 1, 152. Walker, List V, 271.
convergens Walker. List I, 198.
rondanii Bellardi. Saggio Ditt. Mess. I, 68, tab. 2, fig. 11.
haematopotides Bigot. Mem. Soc. Zool. Fr. V, 624, 1892. Habitat; Washington.
notatus Bigot. Mem. Soc. Zool. Fr. V, 623, 1892. Habitat; California.

TABANUS Linne.

Fauna Suecica 1761.

- abdominalis Fabricius. Syst. Antl. 96, 1805. Palisot de Beauvois, Ins. 101, tab. 2, fig. 4. Osten Sacken, Prodrôme II, 434; Supplement 557. Habitat; Ky., Ga., La., Miss., Ks., Ind., Ills., Fla., N. J.
- actaeon Osten Sacken. Prodrôme II, 443, 1876. Habitat; Mass., Conn., Min., Wis., Canada.
- acutus Bigot. Mem. Soc. Zool. Fr. V, 660, 1892. Habitat; La.
- aegrotus Osten Sacken. Western Diptera 219, 1877. Habitat; Cal., Washington.
- affinis Kirby. Faun. Bor. Am. IV, 313, 1837. Osten Sacken, Prodrôme II, 466. Habitat; northern U. S. and Canada from the Atlantic to the Pacific, N. J.
- triligatus* Walker. List V, 183, 1854.
- allynii Martin. Can. Ent. XV, 110, 1883. Habitat; North Carolina.
- americanus Forster. Nov. Spe. Ins. Cent. I, 100, 1771. Osten Sacken, Prodrôme II, 457. Habitat; eastern N. Am.
- limbatus* Palisot de Beauvois. Ins. 54, tab. 1, fig. 2, 1807.
- plumbeus* Drury. Ins. I, tab. 44, fig. 2.
- ruficornis* Fabricius. Syst. Ent. 789; Ent. Syst. IV, 365.
- annulatus Say. Jr. Acad. Phil. III, 32, 1823; Compl. Writ. II, 53. Osten Sacken, Supl. to Prodrôme 555. Habitat; Mo., Ky., Ga., Ks., La.
- astutus Osten Sacken. Prodrôme II, 471, 1876. Townsend Tr. Am. Ent. Soc. XXII, 57. Habitat; Me., N. H., N. Y., Conn.
- atratus Fabricius. Syst. Ent. 789, 1775; Ent. Sys. IV, 366. Bellardi, Saggio, Ditt. Mess. I, 58. Osten Sacken, Prodrôme II, 454. Habitat; eastern N. Am.
- niger* Palisot de Beauvois. Ins. Dipt., tab. 1, fig. 1.
- americanus* Drury. Ins. I, tab. 44, fig. 3.
- validus* Wiedeman. Auss. zwei. I, 113.
- baal Townsend. Tr. Am. Ent. Soc. XXII, 58, 1895. Habitat; Virginia.
- bicolor Wiedeman. Dipt. exot. I, 96, 1821; Auss. zweifl. Ins. I, 188. Osten Sacken, Prodrôme II, 460. Habitat; N. Y., Md., Pa., Ohio, Ills., Canada, N. J.
- ruficeps* Macquart. Dipt. Exot., Supl. 5, 35, 1855.
- fulvescens* Walker. List I, 171, 1848. Osten Sacken, Prodrôme II, 460; Catalogue 1878, 229.
- calens Linne. Syst. Nat. Ed. XII, II, 1000. Fabricius, Ent. syst. IV, 364. Habitat; N. America.
- californicus Martin. Can. Ent. XIV, 210. Habitat; California.
- captonis Martin. Can. Ent. XIV, 211, 1882. Habitat; California.
- carolinensis Macquart. Dipt. Exot. I, pt. 1, 145, 1838. Osten Sacken, Catalogue 1878, 226.
- centron Martin. Can. Ent. XIV, 211, 1882. Habitat; Colorado.
- cerastes Osten Sacken. Prodrôme I, 462, 1876. Habitat; Ky., Wis.
- hirtiocularis* Macquart. Dipt. Exot. Supl. 5, 33, 1855. Osten Sacken, Catalogue 1878, 227.
- centron Marten. Can. Ent. XIV, 211, 1882. Habitat; Colorado.
- cinctus Fabricius. Ent. Syst. IV, 366, 1775. Osten Sacken, Prodrôme II, 464, 1876. Habitat; Atlantic States.
- cingulatus Macquart. Dipt. Exot. I, pt. 1, 144, 1838. Habitat; N. America.

- coffeatus* Macquart. Dipt. Exot. Supl. 2, 23, 1846. Osten Sacken, Pro-drome II, 441. Habitat; D. C., Del., N. Y., Fla., Mass., Ind., Fla., N. J.
- (?) *nigripes* Wiedeman. Dipt. exot. 1, 75, 1821; Auss. zwei. I, 142.
- comastes* Williston. Tr. Ks. Acad. X, 137, 1886. Townsend, Tr. Am. Ent. Soc. XXII, 58, 1895. Habitat; Wash., Or., Col., Col.
- comes* Walker. List IV, 1152. Habitat; N. Y., Hudson Bay.
- inscitus* Walker. List I, 172.
- confusus* Walker. List I, 147. Habitat; N. America.
- conterminus* Walker. Dipt. Saund. 24. Habitat; N. America.
- costalis* Wiedeman. Auss. zweif. Ins. I, 173, 1828. Osten Sacken, Pro-drome, II, 450. Habitat; eastern N. America.
- baltimorensis* Macquart. Dipt. exot. Supl. 5, 34, 1855.
- vicarius* Walker. List I, 187, 1848.
- cymatophorus* Osten Sacken. Prodrôme II, 444, 1876. Habitat; Ky.
- derivatus* Walker. List I, 151. Habitat; N. America.
- dodgei* Whitney. Can. Ent. XI, 37, 1879. Habitat; Kan., Neb.
- dorsonotatus* Macquart. Dipt. exot. Supl. 2, 22, 1846. Habitat; Carolina.
- duplex* Walker. List V, 173, 1854. Habitat; Hudson Bay Territory.
- imitans* Walker. List I, 173, 1848.
- endymion* Osten Sacken. Prodrôme Supl., 556, 1876. Habitat; Georgia.
- epistatus* Osten Sacken. Prodrôme Supl. 555, 1876. Habitat; Hudson Bay Territory, N. J.
- socius* Osten Sacken. Prodrôme II, 467.
- exul* Osten Sacken. Prodrôme Supl. 557, 1876. Townsend, Tr. Am. Ent. Soc. XXII, 60 (var?). Habitat; eastern U. S.
- abdominalis* Wiedeman (not Fabr.). Dipt. exot. I, 65; Auss. zweif. Ins. I, 116.
- ferrugineus* Palisot de Beauvois. Ins. 221, tab. 3, fig. 2.
- flavipes* Wiedeman. Auss. zweif. Ins. I, 137, 1828. Osten Sacken, Prodrôme II, 462. Habitat; Labrador.
- fratellus* Williston. Tr. Ks. Acad. X, 140, 1888. Habitat; Washington.
- frenchii* Martin. Can. Ent. XV, 111, 1883. Habitat; Montana.
- fronto* Osten Sacken. Prodrôme II, 431, 1876; Catalogue 1878, 228. Habitat; Car., Texas., Fla.
- (?) *cheliopterus* Rondani. Nuovi. Annali. d. Sc. di. Bologna, 1850, 192. Osten Sacken, Prodrôme II, 473; Catalogue 1878, 228.
- fulvofrater* Walker. List I, 181, 1848. Habitat; Ills.
- fulvulus* Wiedeman. Auss. zweifl. Ins. I, 153, 1828. Osten Sacken, Prodrôme II, 451. Habitat; Ky., Md., N. C., N. J.
- fur* Williston. Tr. Ks. Acad. Sci. X, 139, 1888. Habitat; Florida.
- fuscipalpis* Bigot. Mem. Soc. Zool. Fr. V, 681, 1892. Habitat; Wash.
- fuscopunctatus* Macquart. Dipt. exot. suppl. 4, 34, 1849. Osten Sacken, Prodrôme II, 432; Supl. 559; Catalogue 1878, 228. Habitat; S. Car., Ga., Fla.
- imitans* Walker. List I, 146, 1848.
- giganteus* DeGeer. Ins. VI, 226, tab. 30, fig. 1. Osten Sacken, Prodrôme II, 458. Habitat Middle States and South Atlantic States.
- bicolor* Macquart. Dipt. exot. suppl. 2, 21.
- caesiofasciatus* Macquart. Dipt. exot. suppl. 5, 32.
- lineatus* Fabricius. Spec. Ins. II, 455; Ent. Syst. IV, 363; Syst. Antl. 94.
- gilanus* Townsend. Psyche VIII, 92, 1897. Habitat; N. Mexico.
- gracilis* Wiedeman. Auss. zweif. Ins. I, 156, 1828. Osten Sacken, Cata-logue 1878, 228. Williston, Tr. Ks. Acad. Sci. X, 140. Habitat; Ga., Fla.

- guttatulus* Townsend. Tr. Ks. Acad. Sci. XIII, 134, 1892; Psyche VIII, 147. Habitat; Las Cruces, N. M.
- haemaphorus* Marten. Can. Ent. XIV, 210, 1882. Habitat; California.
- hirtulus* Bigot. Mem. Soc. Zool. Fr. V, 641, 1892. Habitat; Washington.
- illotus* Osten Sacken. Prodrôme II, 469, 1876. Habitat; Canada.
- incisus* Walker. Dipt. Saund. 26, 1856. Habitat; N. America.
- insuetus* Osten Sacken. West. Dipt. 219, 1877. Habitat; California, Alaska, Wash., Col.
- intensivus* Townsend. Psyche VIII, 93, 1897. Habitat; N. Mexico.
- intermedius* Walker. List I, 173, 1848. Habitat; Hudson Bay Territory.
- lasiophthalmus* Macquart. Dipt. exot. I, pt. 1, 143, 1838. Osten Sacken, Prodrôme II, 465. Habitat; eastern N. America, Columbia, Chile.
- notabilis* Walker. List I, 166, 1848.
- punctipennis* Macquart. Dipt. exot. Supl. 2, 23. Osten Sacken, Prodrôme II, 473.
- leucomelas* Walker. List I, 175, 1848. Habitat; Georgia.
- leucophorus* Bigot. Mem. Soc. Zool. Fr. V, 640, 1892. Habitat; Oregon.
- lineola* Fabricius. Ent. Syst. IV, 369; Syst. Antl. 102. Osten Sacken, Prodrôme II, 448, 1876; Biol. Cent. Amer. I, 56. Habitat; eastern N. America.
- (?) *scutellaris* Walker. Dipt. Saund. 27, 1856.
- simulans* Walker. List I, 182, 1848.
- trilineatus* (Latr.?) Bellardi. Saggio Ditt. Mess. I, 63.
- longus* Osten Sacken. Prodrôme II, 447, 1876; Supplement 559. Habitat; Ks., O., Ky., Fla., N. J.
- lugubris* Macquart. Dipt. exot. I, pt. 1, 145, 1838. Osten Sacken, Prodrôme II, 456. Habitat; South Carolina.
- ater* Palisot de Beauvois. Ins. Dipt. tab. 2, fig. 5. Wiedeman, Dipt. exot. I, 74; Auss. zw. In. I, 136.
- maculifer* Bigot. Mem. Soc. Zool. Fr. V, 641, 1892. Habitat; Wash.
- maculosus* Coquillett. Jr. N. Y. Ent. Soc. X, 138, 1902. Habitat; Mexico.
- marginalis* Fabricius. Syst. Antl. 99, 1805. Osten Sacken, Prodrôme II, 472. Habitat; N. America.
- maritimus* Townsend. Ent. News IX, 167, 1898. Habitat; Texas.
- megerlei* Wiedeman. Auss. zwei. Ins. I, 132. Osten Sacken, Prodrôme II, 457. Habitat; Florida.
- melanocerus* Wiedeman. Auss. zwei. Ins. I, 122. Osten Sacken, Prodrôme II, 440. Habitat; Atlantic States from New Jersey south.
- (?) *exaestuosus* Linne. Syst. Nat. Ed. XII, II, 1000. Degeer, Ins. VI, 229, tab. 30, fig. 5. Fabricius, Ent. Syst. IV, 365; Syst. Antl. 96. Osten Sacken, Prodrôme II, 441.
- melanorhinus* Bigot. Mem. Soc. Zool. Fr. V, 642, 1892. Habitat; Wash.
- mexicanus* Linne. Syst. Nat. Ed. XII, II, 1000. Fabricius, Spec. Ins. II, 457; Ent. Syst. IV, 367; Syst. Antl. 98. Wiedeman, Dipt. exot. I, 76; Auss. zwei. Ins. I, 147. Macquart, Dipt. exot. I, pt. 1, 143. Walker, List V, 215, 259. Bellardi, Sag. Ditt. Mess. I, 59. Osten Sacken, Prodrôme II, 459; Biol. Cent. Amer. I, 56. Habitat; southern U. S., Mexico, S. America, N. J.
- flavus* Macquart. Hist. Nat. Dipt. I, 200.
- inians* Fabricius. Ent. Syst. IV, 368.
- ochroleucus* Meigen. Syst. Besch. II, 62.
- olivaceus* Degeer. Ins. VI, 230, tab. 30, fig. 6.
- punctatus* Fabricius. Ent. Syst. IV, 368.
- sulphureus* Palisot de Beauvois. Ins. 222, tab. 3, fig. 6.
- viridiflavus* Walker. Newman Zoologist VIII, Append. LXVI.

- (var) *limonius* Townsend. An. Mag. Nat. Hist. Ser. VI, XX, 21. Habitat; Mexico.
- microcephalus* Osten Sacken. Prodrôme II, 470, 1876. Habitat; N. H., N. Y., Me., N. J.
- molestus* Say. Jour. Ac. Phil. III, 31, 1823; Compl. Wri. II, 53. Wiedeman, Auss. zwei. Ins. I, 125. Osten Sacken, Prodrôme II, 438. Habitat; Ky., D. C., Ga., Mo., N. C., Tenn., Ks., Fla., N. J.
- mutatus* Walker. Dipt. Saund. 23, 1856. Habitat; United States.
- nebulosus* Palisot de Beauvois. Ins. 222, tab. 3, fig. 4-5. Habitat; N. America.
- nigrescens* Palisot de Beauvois. Ins. 100, tab. 2, fig. 2. Wiedeman, Auss. zweif. Ins. I, 116. Osten Sacken, Prodrôme II, 453. Habitat; Atlantic States.
- nigrovattatus* Macquart. Dipt. Exot. Suppl. 2, 24, 1846. Osten Sacken, Prodrôme II, 449. Habitat; Atlantic States.
- nivosus* Osten Sacken. Prodrôme II, 445, 1876. Habitat; N. J., N. Y., Ohio.
- novae-scotiae* Macquart. Dipt. Exot. Suppl. 2, 24, 1846. Habitat; N. America.
- ohioensis* Hine. Can. Ent. XXXIII, 28, 1901. Habitat; Ohio, Ind.
- pruinosis* Hine. Can. Ent. XXXII, 247, 1900.
- orion* Osten Sacken. Prodrôme II, 442, 1876. van der Wulp, Tijdschr. v. Ent. XXIV, 158. Habitat; Canada, Mass., Conn. N. J.
- pallidus* Palisot de Beauvois. Ins. 100, tab. 2, fig. 3. Wiedeman, Auss. zweif. Ins. I, 118. Habitat; N. America.
- palpinus* Palisot de Beauvois. Ins. 221, tab. 3, fig. 1. Habitat; N. America.
- patulus* Walker. List I, 175, 1848.
- phaenops* Osten Sacken. West. Dipt. 217, 1877. Habitat; Cal., Col.
- politus* Johnson. Ent. News XI, 325, 1900. Habitat; N. J.
- procyon* Osten Sacken. West. Dipt. 216, 1877. Habitat; California.
- proximus* Walker. List I, 147, 1848. Habitat, Florida.
- psammophilus* Osten Sacken. Prodrôme II, 445, 1876. Habitat; Florida.
- pumilus* Macquart. Dipt. Exot. I, pt. 1, 146, 1838. Osten Sacken, Prodrôme II, 448. Habitat; Middle and Atlantic States.
- punctifer* Osten Sacken. Prodrôme II, 453, 1876; West. Dipt. 220. Habitat; Western N. America.
- pygmaeus* Williston. Tr. Ks. Acad. Sci. X, 141, 1888. Habitat; Florida.
- recedens* Walker. List I, 147, 1848. Williston, Tr. Ks. Acad. Sc. X, 138. Habitat; Middle and south Atlantic states.
- catenatus* Osten Sacken. Prodrôme II, 433, 1876; Catalogue 1878, 227.
- reinwardtii* Wiedeman. Auss. zweif. Ins. I, 130. Osten Sacken. Prodrôme II, 461. Habitat; Middle and Atlantic States, Canada, Kan.
- erythroletus* Walker. Dipt. Saund. 25, tab. 2, fig. 1.
- rhombicus* Osten Sacken. Prodrôme II, 472, 1876; West. Dipt. 218. Habitat; Col., Wy., Or., Wash.
- rufofrater* Walker. Dipt. Saund. 26. Habitat; Georgia.
- rufus* Palisot de Beauvois. Ins. 100, tab. 2, fig. 1. Wiedeman, Auss. zweif. Ins. I, 117. Osten Sacken, Prodrôme II, 456; Supplement 559. Habitat; S. Car., Ga., Fla.
- fumipennis* Wiedeman. Auss. zweif. Ins. I, 119.
- sagax* Osten Sacken. Prodrôme II, 452, 1876. Habitat; Ills., Min., N. J.
- scitus* Walker. List I, 181. Habitat; N. America.
- septentrionalis* Loew. Verh. zool.-bot. Ges. VIII, 592. Osten Sacken, Prodrôme II, 467. Habitat; Labrador, Alaska.

- sequax Williston. Tr. Ks. Acad. Sci. X, 137, 1888. Habitat; Oregon.
- sodalis Williston. Tr. Ks. Acad. Sci. X, 139, 1888. Habitat; N. America.
- sonomensis Osten Sacken. West. Dipt. 216. Habitat; California, Alaska.
- sparus Whitney. Can. Ent. XI, 38, 1879. Habitat; Fla., N. J., N. H., Conn., Mass.
- stygius Say. Jr. Acad. Sc. Phil. III, 33, 1823; Compl. Writ. II, 54. Wiedeman, Auss. zweifl. Ins. I, 131. Osten Sacken, Prodrôme II, 454. Habitat; Middle and Southern States.
- sulcifrons Macquart. Dipt. Exot. Suppl. 5, 33, 1855. Osten Sacken, Catalogue 1878, 60 and 228. Habitat; Penn., N. J., Ohio, Ills.
- tectus Osten Sacken. Prodrôme II, 436.
- superjumentarius Whitney. Can. Ent. XI, 37, 1879. Habitat; N. H., N. J., Ohio.
- susurrus Marten. Can. Ent. XV, 111, 1883. Habitat; Montana.
- tener Osten Sacken. Prodrôme II, 440, 1876; Catalogue 1878, 60 and 228. Habitat; Ga., Fla.
- (?) *unicolor* Macquart. Dipt. Exot. Suppl. 2, 22.
- tenessensis Bigot. Mem. Soc. Zool. Fr. V, 660, 1892. Habitat; Tenn.
- tetricus Marten. Can. Ent. XV, 111, 1883. Habitat; Montana.
- tetropsis Bigot. Mem. Soc. Zool. Fr. V, 681, 1892. Habitat; Georgia.
- thoracicus Hine. Can. Ent. XXXII, 247, 1900. Habitat; New York.
- trijunctus Walker. List V, 182, 1853. Osten Sacken. Prodrôme II, 432. Habitat; Florida.
- trimaculatus Palisot de Beauvois. Ins. 56, tab. 1, fig. 5. Wiedeman, Auss. zweifl. Ins. I, 137; I, 132. Macquart, Dipt. Exot. I, pt. 1, 142. Osten Sacken, Prodrôme II, 439. Habitat; Middle and Southern States west to Kansas.
- quinquelineatus* Macquart. Hist. Nat. Dipt. I, 200.
- trispilus Wiedeman. Auss. zweifl. Ins. I, 150. Osten Sacken, Prodrôme II, 464. Habitat; Northern and Middle States, Illinois, N. J.
- turbidus Wiedeman. Auss. zweifl. Ins. I, 124. Osten Sacken, Prodrôme II, 430. Habitat; Ga., Ky., Fla.
- (?) *fusconervosus* Macquart. Dipt. Exot. I, pt. 1, 147.
- variegatus Fabricius. Syst. Antl. 95. Wiedeman, Dipt. Exot. I, 67; Auss. zweifl. Ins. I, 120. Osten Sacken, Prodrôme II, 437. Habitat; Middle States.
- venustus Osten Sacken. Prodrôme II, 444, 1876. Habitat; Tex., Ks., Ohio, Oklahoma.
- vicinus Macquart. Dipt. Exot. I, pt. 1, 143. Habitat; Carolina.
- villosulus Bigot. Mem. Soc. Zool. Fr. V, 684, 1892. Habitat; California.
- vivax Osten Sacken. Prodrôme II, 446, 1876; Catalogue 1878, 60 and 228. Habitat; N. Y., Me., Ohio.
- (?) *marginalis* Wiedeman. Auss. zweifl. Ins. I, 166.
- wiedemanni Osten Sacken. Prodrôme II, 455; Supplement 559. Habitat; Fla., Ga., Ky.
- ater Wiedeman. Auss. zweifl. Ins. I, 136.
- zonalis Kirby. Fauna. Br. Am. IV, 314. Osten Sacken, Prodrôme II, 463; Catalogue 1878, 56 and 226. Townsend, Tr. Am. Ent. Soc. XXII, 58. Habitat; Northern States and Canada.
- flavocinctus* Bellardi. Saggio Ditt. Mess. I, 61. Osten Sacken, Catalogue 1878, 226.
- tarandi* Walker. List I, 156.
- terrae-novae* Macquart. Dipt. Exot. Suppl. 4, 35.

A SYSTEMATIC TREATISE OF OHIO SPECIES.

In the keys which are given below I have included a few species which have never been taken in Ohio, but in the descriptions only such species are considered as have been taken in the state and are deposited in the Ohio State University collection. Before attempting to use the keys one should acquaint himself with the meaning of terms as given below.

EXPLANATION OF TERMS.

Antennae. Always three segmented. Third segment compound, composed of from five to eight annuli or rings, bearing a prominent basal process in *Tabanus*. This process is absent or at least rudimentary in the other genera of our fauna.

Apical-spot. That part of the dark picture of the wing of *Chrysops* beyond the outer border of the cross-band, which term is explained below.

Basal cells hyaline. As this character is used in the key for the females of *Chrysops* some explanation is necessary. Those species which have slight infuscations at the base or apex of either of these cells are treated as having the basal cells hyaline, while those species with these cells infuscated far beyond the middle are placed in the other group. *C. montanus* has the most infuscation of any species placed in the former group, and *C. frigidus* the least of any placed in the latter.

Color of eyes. In life nearly all the species have highly colored bands or spots on the eyes. These are not distinguishable in dry specimens, but may be revived by moisture. However, this process usually destroys many other characters which it is desirable to retain.

Cross-band. The part of the dark picture of the wing of *Chrysops* beginning at the costa in the region of the stigma and proceeding backward, sometimes reaching and sometimes not reaching the posterior border of the wing.

Empodium. The plural form empodia is usually used. A pad or cushion located between the pulvilli at the distal end of each last tarsal segment.

Eyes hairy. This character is very plain in some species, but hard to see in others. It is always most easily seen in the males.

Face. The anterior surface of the head between the eyes and below the antennæ.

Facial callosities. Prominent elevations, one on either side of the face. They vary in coloration.

- Front.* The anterior surface of the head between the eyes and above the antennæ.
- Frontal callosity.* A prominence slightly above the antennæ, present in the female sex only. It varies in form and coloration.
- Hyaline triangle.* The hyaline patch beyond the outer border of the cross-band in Chrysops.
- Ocelli.* The simple eyes are present in many species and absent in others.
- Ocelligerous tubercle.* A prominence in some species of the genus *Tabanus* where the simple eyes would naturally occur. There are no simple eyes in our species of the genus.
- Palpi.* These are the only organs included under mouth parts not considered as belonging to the proboscis. They are prominent and vary in form and coloration.
- Proboscis.* The mouth parts other than the palpi taken collectively. The labium forms a sheath for the others.
- Pulvilli.* A pair of pads or cushions located one beneath each claw at the distal end of each last tarsal segment. Of the three pads seen in this location the two outer are pulvilli and the middle one is the empodium.
- Stigma.* A darker patch in the wing in the region of the union of the second vein with the costa.
- Subcallus.* The part of the front between the antennæ and the frontal callosity. It is denuded in some species. In others it is denuded in the female and pollinose in the male.
- Tegulae.* Two membranous lobes at the base of the wing. Shown in Plate II.
- Wing.* Reference to Plate II will give an understanding of the parts and regions of the wing.

FAMILY CHARACTERS.

The family *Tabanidae* includes medium sized to large insects commonly called horseflies, gadflies, deerflies, dogflies, earflies and various other names. Usually its members are readily recognized at sight by their form and general appearance.

The three jointed antennæ with the third joint annulated and without a style or arista, the rather large tegula, and the well developed pulviliform empodia taken together serve to distinguish them from other flies in case of any doubt.

None of the species are really small; the head is large, larger and hemispherical in the male, smaller and somewhat flattened in the female.

The antennæ are porrect and composed of three segments of which the third is compound, having five or eight annulations, when there are eight the basal one is only slightly longer than:

the others, but when there are five the basal one is much longer than any of the others, often longer than all the others combined.

The eyes are separated in the female and contiguous in the male. They have an area of enlarged facets above in the latter sex, and in life are marked with green and purple markings in both sexes. In dry specimens these markings are lost, but may be partially restored by moisture. Ocelli are present in some species and absent in others; and the occiput is flat or concave. The proboscis projects and in some species is much elongated; the maxillary palps are large and two segmented.

The thorax and abdomen are clothed with more or less hair, but no spines or bristles. The wings are rather large and encompassed by the marginal vein, two submarginal and five posterior cells present, basal cell elongate, anal cell usually and sometimes some of the posterior cells closed. Tegulæ always prominent. Legs ample; pulvilli moderate; empodia developed pulvilliform; middle tibia with spurs at the tip.

Abdomen composed of seven visible segments, broad, never constricted.

Key to the North American Genera.

- | | |
|---|---------------------|
| 1. Hind tibiae with spurs at the tip, sometimes small | 2. |
| Hind tibiae without spurs | 6. |
| 2. Third segment of the antenna composed of eight annuli, the first of which is only a little longer than the following ones | 3. |
| Third segment of the antenna composed of only five annuli, the first of which is much longer than any of the following ones; ocelli present | 5. |
| 3. Front of female narrow; ocelli present or absent; fourth posterior cell at least open | <i>Pangonia.</i> |
| Front of female broad with a large denuded callus; ocelli present | 4. |
| 4. Eyes in the female acutely angulated above; wing in both sexes with a dark picture | <i>Goniops.</i> |
| Eyes in the female not acutely angulated above; wings hyaline in both sexes | <i>Apatolestes.</i> |
| 5. Second segment of the antenna about half as long as the first; eyes in life with numerous small dots | <i>Silvius.</i> |
| Second segment of the antenna as long or but little shorter than the first; wings with a dark picture | <i>Chrysops.</i> |
| 6. Third segment of the antenna without, or with a rudimentary basal process | 7. |
| Third segment of the antenna with a well developed basal process | <i>Tabanus.*</i> |
| 7. Front of female as broad as long the callus transverse | <i>Haematopota.</i> |
| Front of the female narrow | <i>Diachlorus.</i> |

* Including *Atylotus* and *Therioplectes*.

CHRYSOPS Meigen.

Illiger's Magazine II, 367, 1803.

The males and females in this genus are so different that it is often desirable to make observations in the field before associating the two sexes of a species. We have made a special effort to collect the sexes of our local species and have formulated separate keys for each sex. These keys are given below.

Key to the Females.

- | | |
|--|---------------------|
| 1. Apex of the wing beyond the cross-band is hyaline | 2. |
| Apical-spot present | 4. |
| 2. Both basal cells infuscated on their basal half | 3. |
| Second basal cell hyaline; face yellow in the middle | <i>niger.</i> |
| 3. Each side of the thorax with bright yellow hairs | <i>celer.</i> |
| Each side of the thorax with pale hairs | <i>carbonarius.</i> |
| 4. Whole body brown | 5. |
| Abdomen marked with pure black | 6. |
| 5. Basal segment of antenna swollen; abdomen above brown with small yellow triangles on the segments | <i>brunneus.</i> |
| Basal segment of antenna not swollen; abdomen above with darker designs | <i>flavidus.</i> |
| 6. Both basal cells hyaline | 7. |
| First basal cell altogether or to a considerable extent infuscated | 13. |
| 7. Apical-spot not wider than the distance between the costa and second vein at the outer border of the cross-band | 8. |
| Apical-spot wider than the distance between the costa and second vein at the outer border of the cross-band | 9. |
| 8. A black triangle encroaches upon the posterior part of the yellow on each side of the second abdominal segment | <i>moerens.</i> |
| No black triangle on each side of the second segment of the abdomen | <i>callidus.</i> |
| 9. The hyaline triangle is produced beyond the second longitudinal vein toward the costa | 10. |
| The hyaline triangle does not cross the second longitudinal vein | 12. |
| 10. Abdomen black with a middorsal stripe attenuated posteriorly and sometimes a shorter stripe on each side | <i>obsoletus.</i> |
| Abdomen yellow with two converging black spots on the second segment and black spots on the third and fourth | 11. |
| 11. The cross-band reaches the posterior margin | <i>fallax.</i> |
| The cross-band does not reach the posterior margin | <i>hilaris.</i> |
| 12. Apical-spot occupying only the apex of the second submarginal cell | <i>sackeni.</i> |
| Apical-spot occupying the anterior half of the second submarginal cell | <i>montanus.</i> |

13. Body altogether black; femora of all the legs dark brown or black *plangens.*
Body usually distinctly marked with yellow; femora yellow except sometimes at base 14.
14. Face black with a median stripe of yellow pollen *frigidus.*
Face yellowish in the middle 15.
15. Apical-spot large, reaching beyond the second submarginal cell, and invading the first posterior 16.
Apical-spot does not reach beyond the second submarginal cell 18.
16. The hyaline space between the cross-band and the apical-spot is confined to a small triangle in the second and third posterior cells *moechus.*
The hyaline triangle reaches across the first posterior cell 17.
17. Abdomen with a broad yellow longitudinal stripe in the middle enclosed between two black stripes *univittatus.*
Abdomen uniformly black or black with three dull yellow stripes *lugens.*
18. Abdomen yellow with four black stripes 19.
Abdomen black, yellow on the sides, and with yellow triangles on the segments *indus.*
19. Frontal callosity and scutellum yellowish *vittatus.*
Frontal callosity black; scutellum at base more or less blackish *striatus.*

Key to the Males.

1. Apex of the wing beyond the cross-band is hyaline 2.
Apical-spot present 4.
2. Face yellow in the middle *niger.*
Face wholly black 3.
3. Base of fifth posterior cell with a hyaline spot; anal cell nearly hyaline *carbonarius.*
Base of the fifth posterior cell uniformly brown; anal cell infuscated *celer.*
4. Whole body brown 5.
Body black or at least plainly marked with black 6.
5. First segment of antenna swollen; abdomen uniformly brown above, with a small triangle on each segment behind the first *brunneus.*
First segment of antenna not swollen; abdomen above lighter at base with a darker design on each segment behind the first *flavidus.*
6. Abdomen grayish black, or black with or without a median yellow stripe 7.
Abdomen at least yellow on the sides of the first two segments; or with a middorsal row of gray triangles 10.
7. Abdomen black with a middorsal yellow stripe 8.
Abdomen uniformly black 9.
8. The hyaline triangle produced forward to the costa *obsoletus.*
The hyaline triangle not produced beyond the second longitudinal vein *lugens.*
9. Hyaline triangle unusually small, confined to the apices of the second and third posterior cells *moechus.*
Hyaline triangle not unusually small; dark picture of the wing rather dim *plangens.*

10. Apical-spot not wider than the distance between the costa and second vein at the outer border of the cross-band 11.
Apical-spot wider than the distance between the costa and the second vein at the outer border of the cross-band. 12.
11. The yellow on each side of the second segment encroached upon from behind by a black triangle; the yellow spot is very small *moerens*.
The yellow on each side of the second segment not encroached upon by a black triangle, or if so the triangle is very small *callidus*.
12. The hyaline triangle of the wing produced beyond the second longitudinal vein toward the costa 13.
The hyaline triangle not produced beyond the second longitudinal vein 14.
13. The cross-band of the wing reaches the posterior margin *fallax*.
The cross-band of the wing does not quite reach the posterior margin *hilaris*.
14. Abdomen with a middorsal row of large black spots widest before; facial callosities shining black *frigidus*.
Abdomen with a middorsal row of small gray or yellow triangles 15.
15. Abdomen with a middorsal yellow stripe 17.
Abdomen with a yellow stripe on either side of the black which contains the middorsal row of small triangles *montanus*.
Abdomen yellow on the sides of the first four segments but with no suggestion of stripes 16.
16. The cross-band occupies only the apex of the second sub-marginal cell *sackeni*.
The cross-band occupies the anterior half of the second sub-marginal cell *indus*.
17. Scutellum yellow *vittatus*.
Scutellum black 18.
18. Four black stripes on the dorsum of the first two abdominal segments; the inner of these may be united *striatus*.
Two black stripes on the dorsum of the first two abdominal segments *univittatus*.

CHRYSOPS BRUNNEUS n. sp.

Length 8-10 mm. Antennae noticeably longer and the first two segments thicker than in *flavidus*; first and second segments brown, third yellow at the base with apical half black; thorax with four grayish longitudinal stripes separated by brown intervals, the apical spot spreads over a large part of the apex of the wing fading out so gradually that the real extent of it is not clearly defined; a narrow whitish hyaline band is conspicuous along the distal margin of the cross band and occupies part of each of the first submarginal and first, second and third posterior cells; the cross-band fills out the fourth posterior cell and invades the fifth posterior; the margin of the posterior branch of the fifth vein spreads across the apex at the anal cell and communicates somewhat with the cross-band; the first basal cell is infuscated for two-thirds, and the second for about half the length.

The abdomen is clear brown often with very small yellowish triangles in the middle of the posterior part of segments two to five.

The male and female are alike, differing only in sexual characters.

Habitat: Sandusky, Ohio. Many specimens of both sexes.

The species is separated from *flavidus* by the following: The antennæ are longer and have the first two segments thicker and the third colored differently at base. The basal cells are more infuscated, the apical spot less clearly defined and the abdomen more uniformly colored. In *flavidus* the abdomen is distinctly lighter in color at base, but not so in *brunneus*. The former appears to be southern in its range, while the latter is probably northern.

Osten Sacken's description of the abdomen and apex of the wing under *flavidus* would seem to indicate that he had both species before him.

The species is abundant at Sandusky from the latter part of June to the first of August, and is an annoying pest in the vicinity of the marshes. It is abundant at any time of day, but appears to be most numerous and persistent in the evening, and its attacks are prolonged till almost dark in warm weather.

CHRYSOPS CALLIDUS Osten Sacken.

Length 7-9 mm. The width of the apical spot is equal to the distance between the costa and the second vein at the distal end of the first vein. First two segments of the abdomen yellow on the sides and this color on the second is not encroached upon by a black triangle. Basal half or more of the venter of the abdomen plainly yellowish but with a dark stripe or some dark spots on the mid ventral line.

Female: Frontal callosity black; facial callosity yellow; both basal cells hyaline; dorsally the abdominal segments with narrow, yellow hind margins which expand into triangles in the middle, none of these triangles extend forward far enough to entirely divide the black of any of the segments. Lateral margins of the segments behind the third black.

Male: Both basal cells with about the apical third hyaline; the yellow on the sides of the first two abdominal segments is more prominent and the posterior margins of all the segments wider than in the male of *moerens*.

Habitat: All parts of Ohio.

It is exceedingly common all over Ohio during the latter half of May and first half of June, and the females have often been observed attacking horses and cattle. The eggs are laid on foliage over water along the margins of ponds and canals; on a previous page in this paper we have described the eggs and the process of oviposition. The males have been taken on flowers and swept from vegetation growing near water. Although the species is most abundant during the months I have mentioned above, now and then a specimen is seen later, and last summer specimens were procured as late as August 28th, in the northern part of the state.

The hyaline basal cells in the female and the hyaline apical third of the same in the male, and the absence of the black triangle on the posterior margin of the side of the second segment in both sexes, serve to distinguish this species.

CHRYSOPS CELER Osten Sacken.

Length 8-10 mm. Whole body black, apex of the wing beyond the cross band clear hyaline.

Female: Base of antennae yellowish; sides of the thorax with a conspicuous tuft of yellow hairs in front of the wings; both basal cells of the wings brown on the basal three-fifths; cross band very nearly reaching the posterior margin filling out the fourth posterior cell with the exception of a very narrow apex; the fifth posterior cell is infuscated across its base but the apex is hyaline.

Male: Black including all the antennae and the hairs on the sides of the thorax; wing like that of the female except the anal cell is wholly infuscated, and the hyaline spot at the apex of each of the basal cells is shorter; these spots occupy the entire width of both cells.

Habitat: Has been taken in central and southern Ohio, and usually appears by May 15th.

The female is distinguished from all other species by the tufts of yellow hairs on the sides of the thorax. The male is distinguished from that of *niger* by the hyaline spots at the apex of the basal cells, occupying the whole width of these cells; and from that of *fugax* by the cross-band practically filling out the fourth posterior cell.

This is a common species in various parts of Ohio during the latter half of May. The eggs have been observed commonly along the margin of ponds and artificial lakes clinging to various kinds of foliage overhanging the water. The female has been observed ovipositing on different occasions, and is the only species of the genus observed placing its eggs in masses composed of layers one above the other as in *Tabanus*. Both sexes have often been taken from flowers, the females are annoying to stock, and persist in their attacks, and the male is occasionally found resting on foliage.

CHRYSOPS FALLAX Osten Sacken.

Length 6-8 mm. Face, palpi and base of antennae yellow, the hyaline triangle reaches the costa, separating the apical spot from the cross band; the cross band occupies nearly all of the space beyond a line from the apex of the first vein to the apex of the posterior branch of the third vein; the distal border of the cross band is quite regular and is marked by a slight curve from the costa just before the apex of the first vein to the apex of the anterior branch of the fifth vein; the fourth posterior cell is entirely filled out with brown, the posterior branch of the fifth vein is slightly margined with brown on both sides and both basal cells are hyaline.

Female: Facial callosity black; dorsally, abdominal segments black as follows: first with a spot beneath the scutellum, second with two narrow oblique spots, third and fourth each with four nearly square spots, the others entirely black except the narrow yellow posterior margin; ventrally, abdomen yellow basally, marked with black on apical half.

Male: Abdominal spots on the second segment united anteriorly, spots on third and fourth segments small.

Habitat: Medina, Sandusky, Wauseon.

The markings on the abdomen are somewhat variable, and the male has a slight infuscation at the base of each of the basal cells. The two sexes are so near alike that they are easily associated.

The separation of the apical spot from the cross-band distinguishes it from all species except *hilaris*, and *fallax* is noticeably smaller than that species.

The black marking beneath the scutellum is single in *fallax* and divided in *hilaris*.

CHRYSOPS FLAVIDUS Wiedemann.

Length 7-10 mm. First two segments of antennae yellowish, not noticeably thickened; basal part of third segment yellowish with an obscure brown band on its thickest part, apical half black; the thorax has four grayish longitudinal stripes separated by brown intervals; the parts of the wing not occupied by brown are grayish hyaline and not clear as in most species; the hyaline triangle reaches forward to the middle of the first submarginal cell and includes about half of the second submarginal and parts of the first three posterior cells; the cross band fills out the fourth posterior cell; the apex of the anal and part of the fifth posterior are infuscated; usually the apical half of the first basal cell and two-thirds of the second basal are hyaline but some variation is allowable; dorsally the abdomen is brownish, lighter on the first segment and sides of second, and segments two, three and four have a prominent gray triangle in the middle of the posterior part preceded by a dark area which usually takes the form of a geminate spot; the anterior margins of the last three segments are black or brown; the dark markings of the abdomen are somewhat variable.

The male and female are alike, except in the single male I have fully half of the second basal cell is brown.

Habitat: Taken at Cincinnati, Ohio, by Charles Dury.

Regarding the synonymy I am inclined to the belief that *flavidus*, *pallidus* and *canifrons* refer to the species here considered as *flavidus*, for Wiedemann's type came from Florida, Belardi's from Mexico, and Walker's from Georgia. Besides, they all mention the dark markings on the abdomen.

CHRYSOPS FRIGIDUS Osten Sacken.

Length 6-8 mm. Facial callosities shining black with a stripe of yellow pollen between them, palpi yellow; first basal cell of the wing brown on basal three-fifths and at apex, second basal brown on basal half and at extreme apex, cross band not quite reaching the posterior

margin, posterior branch of the fifth vein margined with brown which color spreads across the apex of the anal cell and also unites with the cross band across a large part of the fifth posterior cell, the apical spot unites with the cross band in the marginal and first submarginal cells and entirely fills them out with brown and extends into the anterior part of the second submarginal.

Female: The facial callosities black produced forward and inward and meeting above the mouth, frontal callosity shining black; first two segments of the abdomen broadly yellow on the sides, first segment dorsally with a large black spot beneath the scutellum, second with a black spot which is variable in different specimens, in some it is smaller and confined to the anterior half of the segment, while in others it is larger, widened anteriorly, and may unite with the black of the third segment, a transverse spot on anterior part of third segment occupying nearly its whole width, last three segments black with yellow hind margins, ventrally abdomen yellow with small black spots in the middle of some or all the first four segments, last three segments blackish with yellow hind margins.

Male: Abdomen, dorsally, yellow on the side of the first four segments, middle of each of these segments with a large black spot which is widest before and which does not reach the posterior margin of its segment except on the first where it is confluent posteriorly with the black of the second, last three segments black with yellow hind margins, ventrally, like the female except the black markings are larger than in that sex.

Habitat: Sandusky, Ohio.

Chrysops frigidus is the only North American species of its genus so far described with an apical spot and with the face entirely black in ground color. In other species of its group the ground color above the mouth is yellow. In this particular it agrees with *C. celer* and other members of the group without an apical spot.

CHRYSOPS INDUS Osten Sacken.

Length 7-9 mm. The apical spot fills out the marginal and first submarginal cells, and extends into the second submarginal along the apical three-fourths of the anterior branch of the third vein.

Female: Frontal callosity black, face, palpi and base of antennae yellow; first basal cell of the wing brown except a small patch in the apical third; abdominal segments one to four and oftentimes five and six yellow on the sides; yellow triangles on the middle of the third and following segments produced forward and dividing the black of these segments into two parts, thus a middorsal line is formed composed of a series of triangles; there is a conspicuous triangle on the second segment but it does not extend forward to the anterior margin of that segment.

Male: Much darker in color than the female; usually the first basal cell is entirely filled out with brown, but in all specimens I have seen there is a small hyaline patch at the apex of the second submarginal cell and in some specimens a very small hyaline patch is present in the apical third of the first submarginal; anal cell entirely infuscated; abdominal segments one to four narrowly margined with yellowish on the sides; posterior margins of the segments behind the second narrowly but plainly yellow, and second and following segments with very small yellow triangles; abdomen otherwise clear black. This sex is here described for the first time.

Habitat: Taken in Central Ohio. It appears usually by the middle of May.

This species is one of the first to appear in the spring, and females have been observed ovipositing on plants growing along the margin of a small lake on the University grounds. Males have been taken near where the females were ovipositing and on flowers of Cornus. The eggs are placed in single layers on grass blades that hang out over the edge of the water.

CHRYSOPS LUGENS Wiedemann.

Length 8-9 mm. First segment of the antennae yellow, second variable but usually yellow, third black, face yellow, its lateral callosities black; the hyaline triangle of the wing does not cross the second longitudinal vein; the apical spot includes nearly all of the second submarginal and the apex of the first posterior cells, so that the triangle is narrow and may be said to be lunate; the abdomen is wholly black above or marked on the basal part with three yellow longitudinal stripes.

Female: Frontal callosity black; thorax dorsally with two greenish gray stripes, narrowly separated by brown, first basal cell brown, second hyaline; the cross band fills out the fourth posterior cell; posterior branch of the fifth vein obscurely margined.

Male: Medium stripes of the thorax more yellow than in the female, second basal, fifth posterior, and anal cells largely infuscated; to the unaided eye a subhyaline streak is visible beginning at the margin of the wing and passing the length of the fifth submarginal cell into the second basal and thence toward but not attaining the base of the cell; this sex is much like the female and easily associated with it.

Habitat: Taken at Medina, Ohio.

CHRYSOPS MÖECHUS Osten Sacken.

Length 8 mm. Hyaline triangle of the wing very small occupying only part of the second and third posterior cells.

Female: Face, palpi and base of antennae yellow, frontal callosity black; first basal cell of wing infuscated, second hyaline except a margin along the vein which separates it from the first, the cross band reaches the posterior margin filling out the fourth posterior cell; in the fifth posterior cell there is a margin along the posterior intercallary vein and also along the posterior branch of the fifth; the apex of the anal cell is slightly infuscated; dorsally the markings of the abdomen are variable but four longitudinal rows of dark spots are usually visible.

Male: Face yellow, otherwise whole body including most of the wings black; the only trace of hyaline in the basal cells is a dot on the fourth vein near the base of the discal cell.

Habitat: Common all over Ohio.

The very small hyaline triangle serves to distinguish this species from others, and also to associate the sexes which are strikingly different in coloration.

I have observed the females ovipositing on foliage overhanging a mill race at Georgesville, Ohio, June 4, 1899.

CHRYSOPS MOERENS Walker.

Length 8 to 11 mm. A dark colored species, sides of first two abdominal segments narrowly marked with yellow, that on the second segment encroached upon from behind by a small black triangle. Wings beyond the crossband with a very narrow brown border along the costa; under side of abdomen uniformly black, or at most with suggestions of yellowish in patches.

Female: Frontal callosity black, shining, facial callosity yellow, shining; wings with base, costal cells and crossband, which does not reach the posterior margin, brown or nearly black; the brown margin along the costa beyond the crossband is so narrow as to be nearly obsolete, both basal cells hyaline; the abdominal segments, both dorsally and ventrally are gray margined behind and dorsally these margins expand into triangles in the middle of the segments.

Male: Darker colored than the female, a small patch only hyaline at apex of each of the basal cells; posterior margins and triangles of the abdominal segments less plainly marked than in the female; the yellow on sides of the first two abdominal segments variable, that on second segment present in all my specimens and quite constant, but it is oftentimes lacking altogether on the first segment; this sex usually somewhat smaller than the female.

Habitat: Northern Ohio.

The species is a very common and annoying one at Sandusky through July. The females bite severely and persist in following our small boats through the marshes, and the hotter the sun the more active the flies. The females oviposit on various kinds of foliage in the marshes, oftentimes several rods from shore, where the water is four feet in depth or more. The eggs are deposited in a single layer, and a short time after deposition become pure shining black in color. Just how the young from masses of eggs deposited in such deep water grow to maturity and emerge as adults I have not been able to observe; of course some masses of eggs are deposited very near the shore. The males have been taken in large numbers by sweeping in grass near shore, and on various kinds of flowers which grow in the vicinity. This is the first mention of the male of this species, I have seen in print.

The large size, the abdomen black ventrally and the very narrow costal margin beyond the cross-band in both sexes easily distinguishes this species from others of its group.

CHRYSOPS MONTANUS Osten Sacken.

Length 7-8 mm. Face, palpi and base of antennae yellow; the hyaline triangle does not cross the second longitudinal vein but in the majority of specimens reaches entirely to it; the apical spot covers about one half of the second submarginal cell.

Female: Frontal callosity black; first basal cell of wing infuscated on basal third and on the narrowed part at apex; second basal cell hyaline except a slight infuscation at extreme base; the cross band attains the posterior margin entirely filling out the fourth posterior cell; the posterior

branch of the fifth vein is plainly margined on both sides with brown and this margin communicates more or less with the cross band across the fifth posterior cell; the first abdominal segment has a rather obscure dark patch beneath the scutellum, the second has two elongate oblique black spots connate anteriorly, and sometimes on either side near the posterior margin a very small additional spot; the third and fourth each have four black spots, and in some specimens five has likewise, but usually five, six and seven are uniformly black on the whole anterior part; all the segments behind the first are narrowly margined with yellow; ventrally, abdomen yellow with apex and narrow lines on the sides of some of the segments blackish.

Male: Both basal cells infuscated except a small hyaline patch at the apex of each; the first segment of the abdomen is blackish with the exception of a yellow posterior margin which is slightly expanded on either side, the second has a large quadrate black spot in the middle enclosing a small yellow triangle posteriorly and on each side a narrow longitudinal spot also black; three and four are colored like two; the segments behind the second are plainly margined posteriorly with yellow and five, six and seven are uniformly black in front. These markings form a wide longitudinal black stripe in the middle of the abdomen enclosing small yellow triangles on segments two to four, and on each side of this a much narrower black stripe followed by a still narrower black stripe. Hitherto this sex has not been described.

Habitat: Northern and Southern Ohio.

I have never found the species common except at Cincinnati in the region of a series of small artificial lakes. Here the females were very persistent in attacking me, and I procured males by sweeping the plants that grew along the edge of one of the lakes.

CHRYSOPS NIGER Macquart.

Length 6-8 mm. First segment of antennae yellow, face yellow with cheeks and facial callosities black; body and legs except the metatarsi and part of the following segment on the middle and posterior pairs, black; apex of wings beyond the cross band hyaline.

Female: First basal cell of wing brown except a small spot near the apex bordering the fourth longitudinal vein, second basal hyaline; the cross band nearly fills out the fourth posterior cell but does not enter the fifth posterior; the very narrow hyaline apex of the fourth posterior cell varies slightly in width in different specimens.

Male: Colored like the female except only a small spot at apex of the second basal cell is hyaline, and the fifth posterior, except at extreme base, and anal cells are dimly infuscated.

Habitat: A common species in Ohio and one of the earliest to appear in spring.

The entirely hyaline second basal cell distinguishes the female of this species from all others of its group. The small size of the hyaline spots in the apex of the basal cells are characteristic of the male. The hyaline spot of the first basal is very small and borders the fourth vein.

Different specimens of this species taken in the same locality are quite constant, but there appears to be considerable variation in the amount of infuscation of the first basal cell when specimens from different sections are compared. Specimens from the southern part of its range seem to show the most hyaline in this cell.

Common in May and June in all parts of the state. The females are often observed on horses and cattle.

CHRYSOPS OBSOLETUS Wiedemann.

Length 7-8 mm. Basal segments of antennae yellow, second and third segments usually black although the second is sometimes yellowish; face yellow, its lateral callosities black; thorax above with two medium greenish gray stripes narrowly separated by brown, the hyaline triangle of the wing crosses the second longitudinal vein and in most specimens reaches the costa; the apical spot is confined to the distal parts of the marginal and first and second submarginal cells, the cross band nearly fills out the fourth posterior cell leaving only an obsolete margin at its apex.

Female: Frontal callosity black, both basal cells hyaline; dorsally, abdomen black with a yellow middorsal stripe on the first four segments; variations occur in which an additional yellow stripe is present on either side of the middorsal one, and in some specimens the first two segments are narrowly yellow on the sides.

Male: Several specimens of this sex have the first basal cell infuscated and the abdomen black above with the single middorsal yellow stripe; otherwise like the female.

Habitat: Common all over Ohio.

This is a common species in woods where the females are an annoying pest. I have taken numbers of the males by sweeping along the margins of artificial lakes.

CHRYSOPS SACKENI n. sp.

Length 8-10 mm. Abdominal segments one to four yellow on the sides; apical spot where it joins the cross band equal in width to the marginal cell plus one-fourth of the first submarginal at the same place.

Female: Frontal callosity yellowish on the disk, and black on the margin; annulate portion of third antennal segment black, remainder of antennae, face and palpi yellow; first basal cell infuscated at base for about one-third its length, and at apex on the narrowed portion; second basal cell with a much shorter infuscation at base and scarcely any at apex; cross band abbreviated behind, the fourth posterior cell not filled out with brown; the cloud on the last section of the fifth vein spreads practically across the anal cell and communicates with the cross band across the base of the fifth posterior cell; dorsally, abdominal segments three to six with distinct posterior yellow margins which expand into prominent triangles in the middle; second segment with a prominent triangle but not margined behind; none of the triangles reach the anterior margins of their respective segments; ventrally, abdomen yellow with a mid ventral row of black spots and on each side two narrow black stripes; dorsally, the black on the second segment is composed of two oblique spots connate at the anterior third and attaining both margins.

Male: First basal cell with a hyaline patch before the apex; second basal cell with a long hyaline streak through its center; this streak is expanded near the apex of the cell and communicates with the hyaline patch in the first basal; the veins which bound the anal cell are margined with brown; the yellow on the sides of the first two abdominal segments is less extensive than in the female and the yellow triangles are smaller.

Habitat: Sandusky, Ohio.

The width of the apical spot easily separates this species from *moerens*, *callidus* and *indus*. It is related to *pudicus*, but is more robust, the black on the second segment is more extensive and the cross-band different than in that species. Osten Sacken probably included it with *pudicus*. See his observation appended to that species.

It appears to be a common species on Cedar Point during the first half of June, and the females were very persistent in attacking us while we were collecting the specimens we procured.

CHRYSOPTERUS STRIATUS Osten Sacken

Length 7-9 mm. The two longitudinal stripes on the middle of the thorax are "greenish-gray" and therefore quite different from those of *vittatus*; abdomen, dorsally marked with four longitudinal stripes, the two inner of which usually reach the scutellum and join one another on the first segment and in now and then a specimen they also unite on the anterior part of the second segment; the outer stripes may or may not reach forward onto the first segment; ventrally yellow on basal half, marked with black on middle and sides on apical half.

Female: Frontal callosity varying from light brown to pure black; scutellum black on the disk, margined with yellow; first basal cell of wing brown, second hyaline except a small patch at base; the cross band leaves a very narrow margin at the apex of the fourth submarginal cell; posterior branch of the fifth vein dimly margined on both sides, otherwise the fifth posterior and apical cells are hyaline; the hyaline triangle occupies the apical parts of the first three posterior cells and extends into both submarginal cells in the region of the branching of the third vein; the second submarginal is almost entirely brown in some specimens or in others may be hyaline along the whole length of the posterior branch of the third vein to the extent of half the cell.

Male: Scutellum usually entirely black; a subhyaline streak passes from the margin of the wing lengthwise of the fifth posterior cell into the second basal and toward the base of the wing along the fourth vein; otherwise the second basal and fifth posterior cells infuscated, first basal brown with the exception of a small hyaline spot; apical spot includes nearly all of the second submarginal and may encroach upon the first posterior cell. The male is here described for the first time.

Habitat: Sandusky, Ohio, where it is fairly common.

This species is variable and hard to define; the variations extend to characters which in other species are known to be constant, and in some instances suggest a close relationship with *sequax*, whose type locality is Western Kansas.

CHRYSOPS UNIVITTATUS Macquart.

Length 6-8 mm. Basal segment of antennae yellow, second a little darker and third nearly black; hyaline triangle of the wing reaches or nearly reaches the second vein; the apical spot is large, occupying all the marginal cell beyond the cross band, the broad apex of the first submarginal, all the second submarginal except a small patch at base and the apex of the first posterior; the cross band entirely fills out the fourth posterior cell.

Female: Frontal callosity black, face yellow, its lateral callosities brown or black; first basal cell brown; second basal cell with a very little brown at base; posterior branch of the fifth vein narrowly margined with brown, abdomen with a middorsal yellow, longitudinal stripe with a black stripe of about the same width on either side of it; outside the black stripes the abdomen may be entirely yellow, or all but the first two segments may be dull black, or there may be a narrower black stripe beginning on the third segment and continuing onto the fourth and fifth segments; the last three abdominal segments are often blackish obscuring all stripes in that region.

Male: Second basal cell of wing brown on its basal two-thirds and the fifth posterior more brown than in the female; last three segments of the abdomen black, first four with a middorsal yellow stripe, on each side of which is a wider black one; and outside of the latter on segments three and four is an additional narrow black stripe. The three specimens of this sex I have present no variations. It looks much like the female and is easily associated with it.

Habitat: A common species in June in all parts of the state. The males have been taken on various flowers.

CHRYSOPS VITTATUS Wiedemann.

Length 8-9 mm. Face, palpi and base of antennae yellow; thorax dorsally with four bright yellow longitudinal stripes with brown intervals separating them; scutellum yellow; hyaline triangle of the wing rather small occupying the apical part of the first three posterior cells and extending into the first and second submarginal in the region of the branching of the third vein; a hyaline streak in the second submarginal cell usually follows the posterior branch of the third vein toward the margin of the wing but does not reach this margin.

Female: Frontal callosity yellow; first basal cell of wing brown, second slightly infuscated at base, otherwise hyaline, cross band very nearly attains the posterior margin; the fourth posterior cell except narrow apex, fifth posterior except at base and narrow apex and anal at apex brown, abdomen dorsally with four longitudinal black stripes; the two inner are pale on the first segment and the two outer on the first and second segments; ventrally yellow, darkened at apex, and on either side with two narrow dark lines abbreviated before.

Male: Like the female except the second basal cell of the wing has only the apical third hyaline.

Habitat: Found in all sections of Ohio.

This species is not likely to be confused with others of our fauna except *striatus*, and from this it may be distinguished by the yellow thoracic stripes, and yellow scutellum in both sexes.

The most abundant and widespread species in this section. The females are troublesome to stock, and are commonly observed on horses and cattle with their abdomens filled with blood. The males have been procured along the margin of ponds and on various kinds of flowers.

PANGONIA Latreille.

Hist. Nat. des Crust. et des Ins. III, 1802.

Only a single species of this genus has been taken in Ohio up to the present time. Two others have a range such that they may be considered as probably belonging to our fauna. These three are considered in the key below. The males and females are so much alike that a single key will serve for both sexes.

Key to the species.

- | | |
|---|--------------------|
| 1. Antennae dark | 2. |
| Antennae light reddish or yellow | <i>pigra.</i> |
| 2. Hind borders of the abdominal segments with gray hairs | <i>rasa.</i> |
| Hind borders of the abdominal segments with golden-yellow hairs | <i>tranquilla.</i> |

PANGONIA RASA Loew.

Length 11-13 mm. A brownish species with the hind margins of the abdominal segments white; femora light brown, tibiae and tarsi darker; first two segments of the antennae brown with black hairs, third segment nearly black; wings pure hyaline with brown stigma.

Female: Thorax distinctly gray with three darker longitudinal vittae; abdominal segments with distinct gray margins which in some cases expand into median triangles, most distinct on the second segment; proboscis slightly longer than the height of the head nearly black in color, maxillary palps yellowish, the terminal segment pointing downward and slightly forward, half as long as the proboscis.

Male: General color darker than in the female, the posterior margins of the abdominal segments narrower and consequently less prominent than in the female and with no trace of a median triangle on any of the segments; proboscis about as long as the height of the head, palpi darker than in the female with the terminal segment pointing almost directly forward.

Habitat: Northern and Southern Ohio.

I have taken both male and female on flowers, but have never observed the female around stock.

CONIOPS Aldrich.

Psyche VI, 236, 1892.

There is only one species in this genus. So far as our species of this group are concerned, the genus appears to be sufficiently characterized, but a full knowledge of Central and South American forms is necessary before conclusive results can be reached in the sub-family.

GONIOPS CHRYSOCOMA Osten Sackén.

Length 12-14 mm. Abdomen short and wide; legs pale; wings hyaline at base and on part of posterior margin, otherwise dark almost black in fully matured specimens.

Female: Body entirely pale yellowish although some specimens show a brownish tinge on dorsum of thorax and abdomen, posterior margins of abdominal segments clothed with silvery white hair; face and front wide, eyes small, and pointed above, a line along the inner side of each from the most inferior to the most superior points is very nearly a straight line; proboscis much shorter than the head, palpi nearly as long as the proboscis.

Male: Thorax black above with two narrow longitudinal stripes, abdomen black with a tinge of reddish on the sides and with narrow posterior margins to the segments; clothed with pale yellowish pile.

Habitat: Northern and Southern Ohio.

I have taken both sexes of this species from foliage, but have not observed the female around stock. The peculiar dark markings on the wings of both sexes and the form of the eyes and wide front in the female will serve to distinguish this species from all others of the family in our fauna.

TABANUS Linne.

Fauna Suecica, 1761.

In this genus the markings of the abdomen are much used for distinguishing species. The term gray markings as used in the key below refer to the rows of triangles and to the stripes, and not to the gray margins of the various segments. The males and females of the same species in this genus are very much alike in coloration, so it does not appear necessary to construct a separate key for each sex.

Key to the species.

- | | |
|---|-------------------|
| 1. Eyes bare | 2. |
| Eyes pilose | 16. |
| 2. Abdomen with definite gray markings | 3. |
| Abdomen not with definite gray markings | 13. |
| 3. The gray markings of the abdomen consist of a single longitudinal row of triangles | 4 |
| The gray markings of the abdomen consist of three longitudinal rows of triangles or spots | 9. |
| The gray markings consist of a middorsal stripe running from the scutellum to the end of the abdomen, and usually an additional stripe on each side | 12. |
| 4. Wing uniformly hyaline, but the stigma brown | <i>coffeatus.</i> |
| Wing smoky on basal part or with distinct spots of brown, at least along the cross veins and bifurcation of the third vein | 5. |
| 5. Wing with distinct brown patches other than along the cross veins and the bifurcation of the third vein | <i>venustus.</i> |
| Wing without distinct brown except along the margins of the cross veins and bifurcation of the third vein | 6. |

6. Prevailing color of the abdomen black 7.
- Prevailing color of the abdomen reddish brown 8.
7. Segments two to five with small gray triangles *superjumentarius*.
- Segments three to five with large gray triangles, no triangle
on the second segment *trimaculatus*.
8. Abdominal segments two to five with medium sized gray
triangles, wing of female whitish on the disk; all the
facets of the eyes of the male of nearly the same size *variegatus*.
- Abdominal segments two to five with large gray triangles,
wing of the female not whitish on the disk, large and
small facets of the eyes of the male distinctly differen-
tiated *sulcifrons*.
9. The gray spots on the sides of the abdominal segments are
small and do not touch the hind margin 10.
- The gray spots on the sides of the abdominal segments are
large and touch the hind margin 11.
10. Third antennal segment long and narrow, prevailing color
of the abdomen reddish brown *longus*.
- Third antennal segment rather short and wide, prevailing
color of the abdomen black *pumilus*.
11. Gray stripes on the thorax plainly reaching the scutellum *vivax*.
- Gray stripes on the thorax obsolete behind *nivosus*.
12. Thorax uniformly yellowish pollinose, costal cells yellow *costalis*.
- Thorax dark colored with gray stripes, costal cells hyaline *lincola*.
13. Whole body including the wings black *atratus*.
- Whole body including the wings not black 14.
14. Abdomen black, wings brownish with a darker spot at the
bifurcation of the third vein *stygius*.
- Abdomen brownish, no dark spot at the bifurcation of the
third vein 15.
15. Wings hyaline except the costal cells which are brown *americanus*.
- Wings uniformly brownish *giganteus*.
16. Cross veins and bifurcation of the third vein margined with
brown 17.
- Cross veins and bifurcation of the third vein not margined
with brown 18.
17. Rather large, grayish species, abdomen not distinctly reddish
on the sides *reinwardtii*.
- Medium sized, abdomen broadly reddish on the sides *lasiophthalmus*.
18. Third antennal segment deeply excised making the basal pro-
cess long, general color chocolate brown *cerastes*.
- Third antennal segment not deeply excised 19.
19. Medium sized species, ocelligerous tubercle present 20.
- Rather small species, no ocelligerous tubercle 21.
20. Abdomen broadly and distinctly reddish on the sides *epistatus*.
- Abdomen narrowly or obsoletely reddish on the sides *carolinensis*.
21. Prevailing color of the whole body bright yellowish *bicolor*.
- Prevailing color of the thorax and abdomen black, thinly
dusted with grayish pollen *ohioensis*.

TABANUS ATRATUS Fabricius.

Length 16-28 mm. The male and female of this common species are easily associated as they differ only in sexual characteristics. The whole insect is uniformly black and the thorax and abdomen in well preserved specimens are thinly covered with a whitish dust which is easily rubbed off when specimens are not properly cared for.

It cannot be confused with any species recorded from Ohio but the smaller specimens resemble *wiedemanni* very closely. The wider front, the longer basal process of the third antennal segment, and the shape of the frontal callosity, which is square in *wiedemanni* and wider than high in *atratus*, are distinctive characters. Its much larger size and less shining color distinguish it from *lugubris*.

Habitat: Common all over Ohio.

Never numerous enough to be a particularly striking pest, but specimens have been taken in every month from June to September, so that it is one of the species one may expect to see at any time during the summer. The eggs are deposited around marshy places on grasses and sedges, and the larvæ are to be found by digging in the mud. Larvæ are easily kept in confinement for months, and feed on various invertebrate forms. Fish-worms seem to suit them well, and they have no hesitation in eating their own species, therefore, in rearing each larva must have a separate cage. In one instance where I placed a larva in the same cage with a pupa it was not long before the former bored through the covering of the latter and began feeding upon the soft inner parts. The larvæ push through the soil in all directions in search of food, and the earth in the breeding cage where an active larva is confined usually proves that it is capable of finding everything that will sustain life before giving up in despair.

TABANUS BICOLOR Macquart.

Length 10-13 mm. Whole insect bright yellowish but thorax and a rather wide middorsal stripe on the abdomen darker than the other parts. Eyes pilose but no ocelligerous tubercle present in either sex: Antennae, palpi, proboscis and legs yellow, dorsum of thorax including the scutellum brown in ground color but uniformly covered with yellow pollen; wings hyaline with yellowish veins; middorsal stripe of the abdomen brown, also covered with yellow pollen, usually widest on the first segment and gradually narrowing to the end of the abdomen or sometimes slightly widened again on the last two or three segments. The male and female are marked alike, but in the latter sex there is a tendency for the dark color of the abdomen to be more diffuse with limits not plainly apparent.

Habitat: Sandusky and Danville.

The bright yellowish color of this species is characteristic. It has not been observed annoying stock. Most of my specimens were taken by sweeping in grasses in marshy places.

TABANUS CAROLINENSIS Macquart.

Length 12-15 mm. Eyes pilose; a small ocelligerous tubercle present, palpi pale, antenna reddish, annulate portion of the third segment black or in some specimens the black of the antenna is more extensive, including a large part of the third segment and the superior angles of the first and second segments. Thorax black with obsolete gray stripes, thinly gray pollinose, and clothed, especially on the sides, with gray pile; wings hyaline with base and costal cells pale yellowish, veins brown; legs reddish brown, tarsi and apices of all the tibiae darker; abdomen above brown, lighter colored on the sides, each segment with a gray hind margin which expands into a small triangle at the middle.

Female: Subcallus denuded, shining brown or blackish, communicating with the frontal callosity which is rather small and separated from a linear denuded spot above it by a pollinose interval; vertex in the region of the ocelligerous tubercle denuded, shining brown. Eyes pilose, but this is rather difficult to see if not aided by a strong lense.

Male: Subcallus not denuded; eyes plainly but short pilose; head not noticeably larger than in the female.

Habitat: Ironton, Cincinnati, Newark and Medina.

The abdominal markings are variable and therefore hard to describe. The change from reddish to black is very often so gradual that it is hard to say where the one color ends and the other begins. The gray posterior margins of the segments are very narrow, and the middorsal row of triangles very small. The denuded subcallus of the female in conjunction with the hyaline wings is sufficient to separate it from related Ohio species. It is close to rhombicus of the western states.

TABANUS CERASTES Osten Sacken.

Length 14-16 mm. Eyes pilose, palpi pale, first two segments of the antenna reddish with black hairs; third segment with a very prominent basal process, apex of this process and annulate portion black, remainder reddish; thorax brown with five rather prominent gray stripes, scutellum uniform brown; the vestiture of the thorax and scutellum give a grayish appearance; wings hyaline, veins brown and costal cell smoky; legs brownish with the tarsi and apical part of all the tibiae darker. Abdomen above dark brown, with a middorsal row of gray triangles, a row of prominent gray spots on each side, and gray posterior margin on each segment.

Female: Frontal callosity shining brown and nearly square, as wide as the front, and with an elongate denuded spot above it; sides of the front parallel.

Male: Head noticeably larger than in the female, but the coloration does not differ from that sex.

Habitat: Hanging Rock, on the Ohio River, May 29, resting on foliage.

This species is very much like some others with pilose eyes, but both sexes are readily distinguished by the very prominent basal process on the third segment of the antenna.

TABANUS COSTALIS Wiedemann.

Length 12-14 mm. Palpi yellowish, antennae brownish with the annulate portion darker; thorax including the scutellum uniformly grayish yellow pollinose; legs largely black, base of front tibiae and the middle and hind tibiae except at apex yellowish; wings hyaline with the costal cells yellowish, veins yellowish; abdomen above alternately striped with black and grayish yellow.

Female: Frontal callosity black, above with a very much narrowed prolongation the part of which adjacent to the callosity is sometimes obliterated leaving the upper part as a separate spot.

Male: This sex is much like the female and easily associated with it, but there is a tendency toward obliteration of the distinct markings of the abdomen, the black of the female is replaced by brownish and the stripes may blend so that the whole base of the abdomen is practically one color.

Habitat: Common all over Ohio.

This species may be confused with *nigrovittatus*, *sagar* and *fulvulus*, all of which have the yellowish costal cells. The last two are usually larger than *costalis*, and the spots on the sides of the abdomen above are not contiguous; the former has the apex of the third tibia reddish, while *costalis* has the same part black. So far *nigrovittatus* is known from the Atlantic coast only.

The green-headed fly, as *costalis* is called, is one of our worst stock pests. It is most abundant during August, when a large number of other annoying flies are numerous.

TABANUS EPISTATUS Osten Sacken.

Length 14-16 mm. Eyes pilose, ocelligerous tubercle present; thorax black with rather prominent gray stripes; wing hyaline with extreme base, costal cells and veins brownish, abdomen broadly reddish on the sides.

Female: Subcallus often although not always denuded; palpi distinctly thickened and rather short, front gradually widened above, frontal callosity small, shining brown, rounded above, and separated from a linear shining spot above it by a pollinose interval. Legs brown, femora lighter than the other parts.

Male: Subcallus not denuded in the specimens before me, head rather small, eyes distinctly pilose; palpi short and thick.

Habitat: Sandusky; taken in the tall grass on the border of a marsh July 6th.

This species is very close to *affinis*, but easily separated from it by the enlarged palpi. The palpi in *affinis* are long and slender.

The color of the abdomen is variable, in some specimens there is a distinct black middorsal stripe, but in others this stripe is more or less broken up by the encroachment of the reddish.

TABANUS GIGANTEUS Degeer.

Length 22-25 mm. Palpi pale, antennae reddish; thorax reddish brown with some darker stripes, and thinly clothed with gray pollen, scutellum dark at base reddish at apex, wings uniformly reddish brown, legs reddish with tarsi darker than the other parts; abdomen above dark brown, approaching black with gray hind margins to the segments.

Female: Front quite narrow, yellowish pollinose; frontal callosity shining brown, not quite as wide as the front below, gradually narrowed on upper half and extending above into a linear prolongation which reaches more than half way to the vertex.

Male: Colored like the female, head rather small; eyes composed of large and small facets but the difference in size not so great as in most other species.

Habitat: Wauseon, London, Newark and Cincinnati.

The species occurs late in the season, and I have never found it abundant, though it appears to be widely distributed. Its color and large size easily separate it from all North American species except *americanus*, and that species has hyaline wings with the costal cell dark brown.

TABANUS LASIOPHTHALMUS Macquart.

Length 13-15 mm. Eyes pilose, ocelligerous tubercle present, thorax black with narrow gray stripes which are not prominent; wings hyaline, cross veins and bifurcation of the third vein margined with brown. Abdomen broadly reddish on the sides.

Female: Subcallus denuded, shining black; frontal callosity also shining black, as wide as the front, and separated from a denuded spot above by a pollinose interval; front slightly widened above.

Male: Subcallus not denuded, eyes very plainly pilose, head about equal in size to that of the female.

Habitat: Common in all parts of the state from May 15 to June 15.

Very easily recognized by its pilose eyes in connection with the denuded subcallus and brown margins to the cross veins and bifurcation of the third vein.

TABANUS LINEOLA Fabricius.

Length 12-15 mm. Palpi white, antennae reddish; annulate portion of third segment darker; thorax brown and gray striped, the latter color not prominent; wings hyaline; legs reddish, apex of the front tibia plainly, apexes of middle and hind tibiae faintly, and all of the tarsi dark brown; abdomen above brown or black with three prominent, gray stripes.

The males and females of this species are easily associated. In the latter sex there is sometimes a confusion of colors; the dark is replaced by reddish but the gray middorsal stripe is always prominent in all well preserved specimens.

Habitat: Common all over Ohio.

This and *costalis* are near together in size, but the hyaline costal cell and gray striped thorax distinguish *lineola*. It is an annoying pest during the first part of the summer.

TABANUS LONGUS Osten Sacken.

Length 14-15 mm. General color brownish, form somewhat elongate; palpi white with short hairs, part of which appear black; antennae reddish, third segment black on apical part; thorax brownish with faint grayish stripes, wings hyaline, legs brownish, tibiae especially the last four segments darker; abdomen above brown with narrow, gray hind borders to the segments; a row of faint elongate spots on the middorsal line, these form a continuous row and therefore take on the appearance of a stripe, each of the first five or six segments of the abdomen have on either side a small somewhat oblique spot which does not touch either margin.

Female: Front slightly wider above, clothed with grayish yellow pollen; frontal callosity nearly square, dark brown, and either united or separated from a shining spot which lies above it and which appears to be the upper part of the linear prolongation seen in many species.

Male: Like the female except in sexual characteristics.

Habitat: Medina, Ohio, where it is common and often observed on horses.

TABANUS NIVOSUS Osten Sacken.

Length 12-14 mm. Palpi pale yellow, antennae black, five narrow gray stripes on the anterior part of the thorax, these are obsolete behind, wings hyaline with brown veins, legs black, tibiae more or less reddish; abdominal segments above with very narrow gray hind borders which expand into small gray triangles in the middle, prominent gray markings on the sides of the segments, these markings get smaller gradually from before backwards, and outwardly from them on each side is a row of black spots which vary in size in different specimens.

Female: Sides of the front parallel, frontal callosity brown, nearly as wide as the front, and above with a linear prolongation which reaches half way to the vertex.

Male: The two sexes are easily associated but the male usually has most gray on the abdomen.

Habitat: Sandusky, where it is common.

This species resembles *vivar* somewhat, but the pale yellow palpi in both sexes, the parallel sides to the front in the female and the lack of prominent gray stripes on the thorax are characteristic of *nivosus*. It appears to be partial to stagnant water, while *vivar* breeds in swift flowing streams. It is one of the Ohio species which readily attacks man, and is somewhat of an annoyance at the bathing beach, following out over the water as far as one is pleased to go.

TABANUS OHIOENSIS Hine.

Length 10 mm. Opaque black, eyes pilose, legs pale except the bases of all the femora which are black; whole body clothed with rather long gray hairs and a thin dusting of grayish pollen.

Female: Front and face very pale yellowish pollinose, palpi pale, antennae yellow; frontal callosity and ocelligerous tubercles wanting, wings hyaline with pale yellowish veins, abdomen with just a trace of red on the sides of the first two segments, otherwise dark and the gray hairs on the posterior border of each segment above gives the appearance of the segments being margined with gray posteriorly.

Male: Abdomen plainly red on the sides of the first three segments; otherwise colored as in the female.

Habitat: Columbus, Danville and Medina.

This species belongs to the same group with *bicolor* and *thoracicus*, but its much darker color serves to recognize it readily. Like *bicolor* it frequents marshy places, and is most readily procured by sweeping in grasses growing in such places.

TABANUS PUMILUS Macquart.

Length 8-10 mm. First segment of the antennae and annulate portion of the third black, thorax black with distinct gray stripes, wings hyaline; abdomen above black with narrow gray margins to the segments, a middorsal row of gray triangles, each in connection with the posterior margin of its segment, and on either side of this row of triangles a row of small nearly round gray spots none of which touch either margin of the segments.

Female: Front distinctly wider above, frontal callosity shining black, nearly square and occupying nearly the whole width of the front. Abdomen sometimes reddish on the sides.

Male: Head large, the division between large and small facets well marked and there is a striking difference in the size of the facets. The abdomen in some specimens has a suggestion of reddish on the sides.

Habitat: Medina, Danville and Cincinnati.

In appearance very much like *fratellus* of the Northwest, and *sparus* described from New Hampshire. In the latter species the gray spots on the sides of the abdomen above are larger, and on the second and third segments are broadly contiguous with the hind margin. The third antennal segment is noticeably narrowed in *fratellus*, while in *pumilus* it is wide with a distinct basal process.

In the field this species has habits much like a *Chrysops* for it persists in its attacks on the collector. Specimens are easily taken with the net at such times. It is often observed annoying horses and cattle.

TABANUS REINWARDTII Weidemann.

Length 14-19 mm. Eyes pilose, palpi pale yellowish, antennae black, sometimes first segment reddish; thorax brownish, thickly clothed with rather long gray hairs, above with white stripes; legs largely dark colored but the basal part of all the tibiae yellowish, this color is least extensive on the anterior pair; wings hyaline with the cross veins and bifurcation of the third vein margined with brown; abdomen with a middorsal row of prominent gray triangles and on either side of this a row of oblique gray spots which connect with the narrow gray hind margins of the segments.

Female: Frontal callosity shining black, scarcely as wide as the front, slightly higher than wide and with a linear prolongation above; sides of the front parallel.

Male: Thorax more thickly pilose than in the female, head only slightly larger, eyes very distinctly pilose.

Habitat: Cincinnati and Medina.

TABANUS STYGIUS Say.

Length 20-22 mm. Third segment of the antennae red at base, blackish at apex, first and second segments and palpi dark; legs black, often the tibiae reddish at base; wings yellowish brown with the posterior border approaching hyaline, a brown spot on the bifurcation of the third vein, also the transverse vein closing the discal cell margined with brownish; abdomen uniform black.

Female: Thorax dorsally plainly whitish pollinose with more intense longitudinal lines.

Male: Thorax dorsally uniform grayish brown in well preserved specimens.

Habitat: Sandusky, Wauseon and Cincinnati.

It is closely related to *nigrescens*, but in the specimens before me the wings have more color on the anterior part than in that species. In *nigrescens* the dorsum of the thorax is shining black, thinly whitish pollinose on anterior fourth in both sexes, therefore the difference in color in this region is distinctive when dealing with perfect specimens. However, the males are very close at best, and easily confused.

It resembles *punctifer* somewhat, but this species has the front tibia white on basal third and the thorax uniformly white in both sexes.

The females oviposit on *Sagittaria* growing in shallow water at Sandusky, and on a previous page I have fully described this process.

TABANUS SULCIFRONS Macquart.

Length 18-21 mm. Palpi brownish, antennae nearly black with the third segment brownish at base; legs dark, bases of tibiae darker; wings with a distinct brownish tinge, cross veins at the end of the discal cell and bifurcation of the third vein margined with brown.

Female: Front with parallel sides, frontal callosity shining brown, not quite as wide as the front, nearly square and with a linear prolongation above. Segments of the abdomen above with prominent gray, hind margins which expand into large gray triangles in the middle; usually a black mark on the anterior part of each of the second and third segments at the apex of the gray triangle.

Male: The division between the large and small facets of the eye prominent; head slightly more convex than in the female but nearly of the same size, coloration of the whole body the same as in the female.

Habitat: Common in all parts of Ohio in August.

This species is very near *exul* and *abdominalis*, neither of which have been recognized from this state, although it is within their range. The large, gray, abdominal triangles are characteristic of *sulcifrons*. In *abdominalis* the first posterior cell is closed, and the front in the female is noticeably narrowed. In *exul* the head of the male is sub-hemispherical and the abdominal triangles are moderate. Regarding its relationship with *variegatus* see under that species below.

In certain parts of Ohio this species is so abundant that it is one of the worst of stock pests.

TABANUS SUPERJUMENTARIUS Whitney.

Length 16-20 mm. This species resembles *trimaculatus* in many respects but the following differences may be noted: the legs are uniformly black or at least dark with occasionally a suggestion of reddish at the bases of the tibiae; the wings are uniformly subhyaline with no darker margins to the cross veins and bifurcation of the third vein; dorsally, abdominal segments two, three, four and five each with a very small white triangle in connection with the middle of the posterior margin; ventrally, there is not the contrast between the colors of the median and lateral areas exhibited in *trimaculatus*.

The male and female are colored alike except in the specimens before me the thorax is not so distinctly white in the former as in the latter.

Habitat: Akron and Cincinnati.

TABANUS TRIMACULATUS Palisot de Beauvois.

Length 16-19 mm. Antennae dark, nearly black, palpi yellowish; thorax dorsally with whitish pollinose stripes and brownish intervals, scutellum uniformly whitish pollinose; legs black except base of all the tibiae which are white; wings hyaline, costal cell brown, bifurcation of the third vein, cross veins and sections of veins that have a transverse direction margined with brown; abdomen dorsally black with a large white triangle in connection with the middle of the posterior margin of each of segments three, four and five; abdomen ventrally white on the sides and a wide black median stripe.

The male and female differ only in sexual characteristics.

Habitat: All sections of the state during the latter part of May and the first half of June. Occasionally as late as July first.

The three prominent triangular white markings of the abdomen easily distinguish this species.

TABANUS VARIEGATUS Fabricius.

Length 20-23 mm. This species is much like *sulcifrons*, but the gray triangles in the middle of the abdominal segments are smaller than in that species and the disk of the wings, at least in the female, have a suggestion of whitish.

Female: Gray triangles of the abdomen prominent, those on the second and third and sometimes the fourth segments preceeded by a black mark, a blackish marking at the lateral margin of each abdominal segment and last two or three segments largely dark.

Male: What is most probably the male of this species as it was taken in the same locality with the females may be described as follows: colored much like the female and therefore much like *sulcifrons*, but the middorsal row of triangles are very small and preceded by black markings on the second, third and fourth segments; cross veins at the apex of the discal cell, and the bifurcation of the third vein narrowly margined with brown; the facets of the eyes nearly uniform in size, those on the disk of the eye are slightly larger than at the margin but the difference is no where near as striking as in the male of *sulcifrons*.

Habitat: Central Ohio.

TABANUS VENUSTUS Osten Sacken.

Length 13-15 mm. Antennae and palpi brownish, thorax with white stripes and brown intervals, scutellum uniformly whitish pollinose; wings variegated with brown and hyaline as follows: base hyaline as far out as the humeral cross vein, beyond this a brown band extending from costa to posterior margin and occupying about half of the anal cell, then follows a shorter band partially confluent with the former and surrounding the cross veins which close the basal cells, the brown apex of the marginal cell is confluent across the first submarginal with the prominent brown spot at the bifurcation of the third vein, the transverse veins closing the discal cell are broadly margined and a lighter brown space follows the posterior border of the wing to its apex where it unites with the darker brown in that region.

Female: The posterior margins of the abdominal segments above are gray and expand into prominent triangles in the middle of segments two, three and four. In the middle of the venter is a wide brown stripe bordered on each side by lighter.

Male: This sex is like the other except the dorsal markings of the abdominal segments are expanded laterally and give the appearance of wide posterior margins.

Habitat: Cincinnati, Ohio, June 25.

Taken by Mr. Charles Dury, who has donated a male and female to the University collection.

This is the only species of *Tabanus* in our fauna with the wings variegated on basal half.

TABANUS VIVAX Osten Sacken.

Length 14-16 mm. Slightly elongate, antennae black, first segment partially reddish especially in the female, face clothed with gray hairs and pollen, the latter having a yellowish tinge; thorax with five gray stripes separated by black, scutellum uniformly black with gray hairs on the

posterior margin and with darker hairs on the basal part, wings hyaline, legs somewhat variable but inclined to black with the basal part of the tibiae yellow, abdomen with a prominent middorsal row of gray triangles and gray spots on each side.

Female: Palpi light yellow front noticeably gradually widened above, frontal callosity below nearly as wide as the front, about square, above with a narrowed extension which reaches half way to the vertex; segments of the abdomen above with gray posterior margins which expand into prominent triangles in the middle; first two segments nearly uniform gray on the sides, next three segments with extensive gray markings enclosing a black patch on the anterior part of the segments, last three segments largely black on the sides; the black on the second segment takes the form of two spots connected before and produced laterally so as to include the anterior margin of the segment; on the following three segments the black takes the form of four spots, the middle two of which are united before.

Male: Antennae black, palpi darker than in the female, and the legs may be said to be uniform black except that the bases of all the tibiae are pale; abdomen with more gray than in the other sex but the arrangement is the same.

Habitat: Oxford, Georgesville, Loudonville and Medina.

The two sexes are easily associated. The species may be confused with *nivosus*, *coffæatus*, *longus* and some of the species with hairy eyes, but these latter need not enter into the case if care is exercised. From *longus* its uniform black instead of reddish color is distinctive, *coffæatus* has only the posterior margins of the segments white on the sides, and a reference to the description of *nivosus* above will reveal the difference between *vivax* and that species.

The larvæ live in streams, and the females have been observed ovipositing on stones in ripples. The egg mass is not so convex as in many other species, but covers more surface.

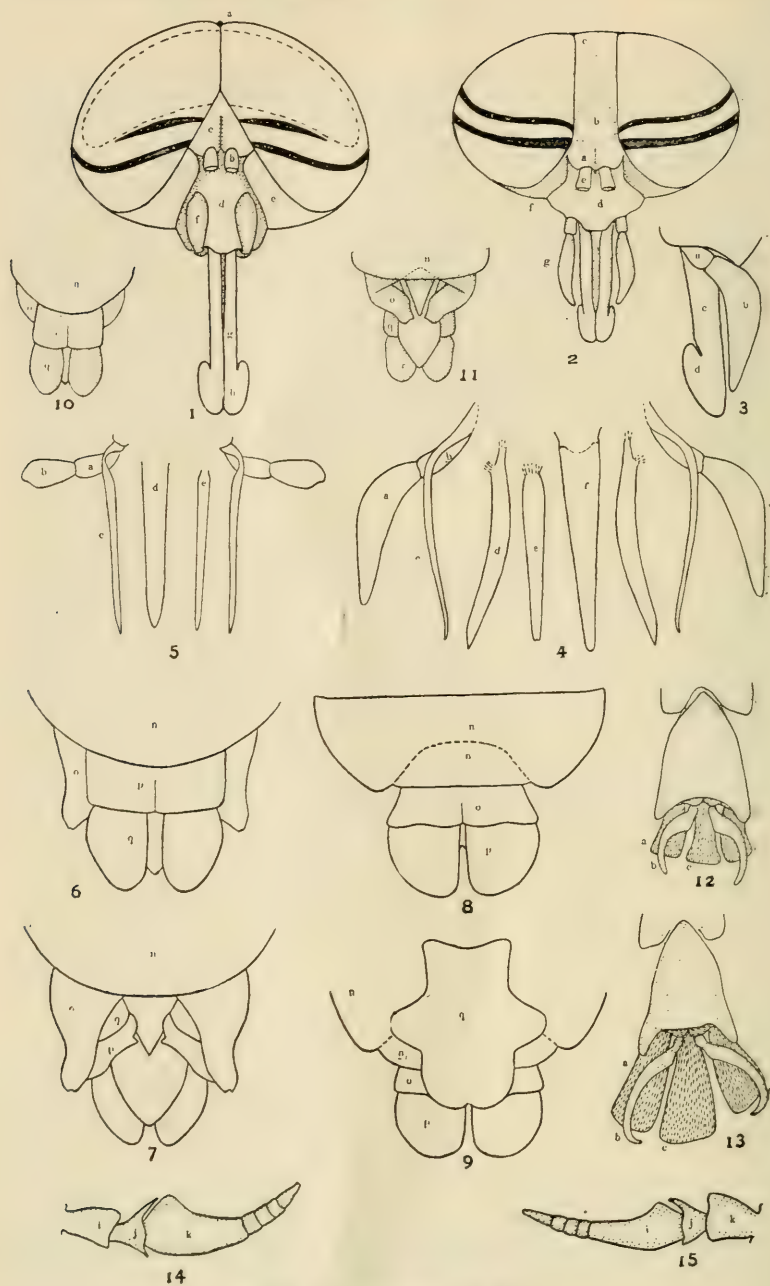


PLATE I.

All the figures were taken from *Tabanus sulcifrons*.

Fig. 1. Anterior of head of male. The greater part of this view is occupied by the compound eyes on the surface of which are to be seen the transverse green bands which are represented by heavy black lines. The space included within the dotted lines represents the location of the enlarged facets. a, vertical triangle; b, first segment of one of the antennae; c, frontal triangle, a plus c form the front; d and e, face, e, cheek; f, one of the maxillary palpi; g, proboscis; h, labella.

Fig. 2. Anterior view of head of female. c, front which includes all the space down as far as the base of the antennae; b, frontal callosity with linear extension above; a, subcallus; d, f, face, f, cheek; e, basal segment of antennae; g, maxillary palpus.

Fig. 3. Side view of proboscis and maxillary palpus of female. c, proboscis; d, labella; a, basal segment; b, apical segment of a maxillary palpus.

Fig. 4. Mouth parts of female. a, apical segment; b, basal segment of maxillary palpus; c, maxilla; d, mandibles; e, hypopharynx; f, labrum.

Fig. 5. Mouth parts of male. a, b, maxillary palpus; c, maxilla; d, labrum; e, hypopharynx.

Fig. 6. Dorsal view of segments 8, 9, 10 of the male abdomen. n, p, q, segments 8, 9, 10, respectively; o, basal segment of clasper.

Fig. 7. Ventral view of Fig. 6. n, q, r, segments 8, 9, 10 respectively; o, p, segments 1 and 2 of claspers respectively.

Fig. 8. n, o, p, dorsal view of segments 8, 9, 10 of female abdomen respectively.

Fig. 9. Ventral view of Fig. 8. q, infraanal plate.

Fig. 10. Same as Fig. 6, showing different position of male claspers.

Fig. 11. Same as Fig. 7, showing different position of claspers. The second segment of the claspers is folded under the first.

Fig. 12. Last segment of female front tarsus. a, pulvillus; b, claw; c, empodium.

Fig. 13. Last segment of male front tarsus lettered as in Fig. 12.

Fig. 14. Female antenna. i, j, k, segments 1, 2, 3 respectively. The third segment is prominent at base and composed of five annulations, the basal one of which is longer than the others combined.

Fig. 15. Male antenna.



HINE on "Tabanidæ of Ohio."

PLATE II.

I, II, III, IV, V, VI, first, second, third, fourth, fifth, sixth longitudinal veins respectively; VII, costa or costal vein; VIII, auxiliary vein; IX, transverse shoulder vein; X, small cross-vein; XI, posterior cross-vein; XII, anterior branch of the third vein; XIII, posterior branch of the third vein; XIV, anterior intercalary vein; XV, anterior branch of the fifth vein; XVI, posterior intercalary vein; XVII, anterior basal transverse vein; XVIII, posterior branch of the fifth vein.

a, b, c, first, second and third costal cells respectively, or costal cell; d, marginal cell; e, f, first and second submarginal cells respectively; g, h, i, j, k, first, second, third, fourth and fifth posterior cells respectively; l, discal cell; m, n, first and second basal cells respectively; o, anal cell; p, axillary cell.

1, anal angle; 2, alula; 3, antitegula; 4, tegula; 5, axillary incision.

The drawing is taken from the wing of *Tabanus Stygius* Say.

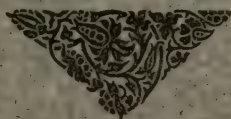
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Special Papers—No. 7. "Ecological Study of Big Spring Prairie."

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Stair, L. D., 1062 Madison St., Cleveland	Werthner, William, Bot., Steele High School, Dayton
Sterki, Victor, Conch., Bot., New Philadelphia	Westgate, Lewis G., Geol., Delaware
Stockberger, W. W., Bot., Granville	Wetzstein, A., Bot., St. Marys
Stoner, Minnie A., Dom. Sci., O. S. U., Columbus	Whitney, W. C., Biol., Geol., Westerville
Storke, Sophia D., 167 Whitman St., Cleveland	Williamson, E. Bruce, Ichth., Ornith., Bluffton, Ind.
Surface, F. M., Zool., Bot., Eaton	Wilson, Miss S. S., Geol., Phys. Geog., 97 N. 20th St., Columbus
Sutton, J. G., Physics, Geol., Rushsylvania	Wilkinson, E., Bot., Mansfield
	Wright, G. Frederick, Geol., Oberlin
	Wright, Albert A., Geol., 123 Forest St., Oberlin
Total membership..... 158	

REPORT OF THE TWELFTH ANNUAL MEETING
OF THE
Ohio State Academy of Science.

ANNUAL MEETING.

The twelfth annual meeting was held at the Ohio State University, Columbus, November 28 and 29, 1902. Of the forty-three papers on the program issued November 10, forty were read. The attendance at the several sessions averaged about thirty-five, most of them members, twenty new members were elected.

The by-laws were amended so as to authorize "the executive committee to elect to membership candidates proposed in the regular manner during intervals between meetings."

The publication committee reported that for lack of space in the Academy's last annual report several papers read at the previous meeting were crowded out and, with the consent of the authors, published in the Ohio Naturalist. The report however, contained, in addition to the usual matter, the constitution and by-laws, with all amendments to date, and the president's address.

The trustees reported the receipt of a check of \$250 from Emerson McMillin to continue his research fund. Lynds Jones gave an account of work done with the aid of this fund in gathering data for a catalogue of the birds of Ohio, to be published by the Academy.

REPORT OF THE COMMITTEE ON THE TOPOGRAPHIC
SURVEY OF THE STATE.

We are happy to report that without any special labor on the part of the Committee, the Legislature, at its regular session for 1902, continued its appropriations for field work during the next two years, granting \$20,000 for 1902, and \$30,000 for 1903. This work is prosecuted in cooperation with the United States

Geological Survey, which expends an equal sum with the State, and undertakes the engraving and printing of the maps entirely at its own expense. There was a friendly interest in the progress of this important work on the part of the officers and members of both houses of the Legislature, but especial credit and thanks should be given to Hon. A. G. Comings of Lorain county for his constant watchfulness over this item of the appropriation bills.

The amount of territory surveyed in 1902 was somewhat less than that covered in 1901 for various reasons. The Director of the United States Geological Survey writes as follows concerning the recent work:—

“By request of the State authorities, work during the present season was mainly confined to the eastern part of the country, so that a systematic and extensive study of the oil, gas and coal district might be taken up as soon as possible. The rugged and broken character of the topography in that district has made the work slow and expensive, but it is believed that the results will fully justify the cost in time and money.

“During the next field season it is expected that work will be more generally distributed over the State, and that a much more extensive area will be covered.”

The maps submitted show that seven quadrangles have been completed, each measuring a quarter of a degree each way, and located as follows:—

Three quadrangles in Stark, Columbiana, Carroll and Harrison counties, covering the cities of Alliance, Steubenville and East Liverpool.

Three quadrangles in Washington county and crossing into West Virginia, covering Marietta and Parkersburg.

One quadrangle in Franklin and Delaware counties, covering Westerville.

One in Cuyahoga county, covering Berea.

Besides the seven completed, seven others are partly done and will be completed by the end of June next. These are located in Carroll, Belmont, Monroe, Noble and Washington counties.

The primary triangulation, which has to precede other work, and which does not show upon the completed maps, has been extended over fifteen new quadrangles, mostly in the Hocking river region.

The engraving and final printing in three colors of the maps of the areas surveyed has not yet been completed, but a limited number of photographic proofs of the areas covered in 1901 can be secured.

The earnest and well sustained interest of the members of the Academy in this undertaking has already been an important

factor in its prosecution; and while its progress for another year is already assured, it is to be hoped that a constantly increasing interest on the part of all the intelligent people of the state may still sustain it, until every county is completely covered.

Respectfully submitted,

ALBERT A. WRIGHT, *Chairman.*

W. G. TIGHT,

C. E. SLOCUM,

GEO. W. GILL,

J. A. BOWNOCKER,

Members of the Committee.

After the reading of this report the efforts on behalf of the survey of Edward Orton, State Geologist, and of C. E. Sherman, who after the death of Professor C. N. Brown, was appointed by the governor to represent the interests of the state, were mentioned as deserving commendation.

No field meeting was held during the summer of 1902.

PAPERS READ.

1. Opportunities for faunal studies at the Lake Laboratory at Sandusky - - - - - HERBERT OSBORN
2. A list of Protozoa observed during the summer of 1902 - - - - - F. L. LANDACRE
3. Ohio Batrachians and Reptiles - - - - - MAX MORSE
4. A note on the significance of the size of nerve fibres in fishes - - - - - C. JUDSON HERRICK
5. Report on the development of the bones in the legs of our domestic animals - - - - - W. F. MERCER
6. The Tabanidae of Ohio - - - - - JAS. S. HINE
7. A list of Ohio Syrphidae - - - - - JAS. S. HINE
8. Remarks on the occurrence of Periodical Cicada in Ohio in 1902 - - - - - HERBERT OSBORN
9. Note on the occurrence of the Cigarette Beetle in Columbus - - - - - HERBERT OSBORN
10. Unusual abundance of a Myriopod - - - - - MAX MORSE
11. New Heliconias from Guatemala and elsewhere - - - - - ROBERT F. GRIGGS
12. Further notes on Smut Experiments - - - - - OTTO E. JENNINGS
13. The life history problem of the Heteroecious Rusts - - - - - W. A. KELLERMAN
14. Eleven new species of fossil plants - - - - - H. HERZER
15. Some Algae from Sandusky Bay - - - - - LUMINA C. RIDDLE

16. The three forms of Prickly Lettuce in Ohio - W. A. KELLERMAN
17. Annual report on the State Herbarium and plants new to the
State List - - - - - W. A. KELLERMAN
18. Additions and corrections to the Sandusky Flora - E. L. MOSELEY
19. The Flora of Little Chicken Island - - - JOHN H. SCHAFFNER
20. Ohio Stations for Myriostoma - - - JOHN H. SCHAFFNER
21. New Discoveries at the Baum prehistoric village site, Ross
County, Ohio - - - - - WM. C. MILLS
22. The Gartner Mound - - - - - WM. C. MILLS
23. Two botanizing trips in the mountains of West Virginia - -
- - - - - W. A. KELLERMAN
24. Two fishes from the Upper Helderberg group - - H. HERZER
25. The Darnell Mastodon - - - - - WM. C. MILLS
26. General climatic conditions of Ohio - - - OTTO E. JENNINGS
27. Some problems in Montana forestry - - - THOS. BONSER
28. Three interesting tropical plants - - - ROBERT F. GRIGGS
29. An ecological study of West Mansfield Swamp, — preliminary
report - - - - - W. A. KELLERMAN
30. Final report on Big Spring Prairie - - - THOS. BONSER
31. Microscopic life forms in Brush Lake - - LUMINA C. RIDDLE
32. Preliminary report on the plant ecology of Brush Lake - -
- - - - - JOHN H. SCHAFFNER
33. Identification of flint from the prehistoric flint quarries of
Licking County, Ohio - - - - - WM. C. MILLS
34. Currents in Sandusky Bay - - - - - E. L. MOSELEY
35. The Ohio Erysiphaceæ—Keys and Distribution - - -
- - - - - W. A. KELLERMAN and J. G. SANDERS
36. Additions to the Cuyahoga County Flora . . . LESLIE D. STAIR
37. Additions to the State Flora - - - - - LESLIE D. STAIR
38. Trees and shrubs on the Ohio State University campus with
dendrological notes - - - - - OTTO E. JENNINGS
39. The meteor of September 15th - - - - - E. L. MOSELEY
40. Report of progress on the plant ecology of Ohio - - -
- - - - - JOHN H. SCHAFFNER
41. Variation of *Carex lurida* - - - - - W. A. KELLERMAN
- President's Address—The Dietetic Value of Fruit - - -
- - - - - WILLIAM R. LAZENBY

E. L. MOSELEY, *Secretary.*

PRESIDENT'S ADDRESS.

THE DIETETIC VALUE OF FRUIT.

WILLIAM R. LAZENBY.

In order to support life and growth and to maintain the strength and efficiency of the human body, some things are absolutely necessary. Among these, named perhaps in order of importance, are, *pure air; wholesome, nutritious food; prompt and regular removal of the excreta; unbroken sleep; and some form of muscular exercise.*

No one can long enjoy a full measure of health and strength without due regard to each and every one of these.

Pure air is placed first, for if this is lacking, however great the attention to the others, health is soon undermined.

Ordinarily we supply the body with food in three daily meals, with intervals ranging from four to twelve hours, and this fully meets the demands of the stomach. The demands of the lungs are more imperious. They require, at least, 20,000 meals a day with intervals of only a few seconds. But if pure air is absolutely essential to good health, food is no less so. It is necessary to form the material of the body and repair its wastes: it is also necessary to keep up the proper temperature and furnish the muscular and other power that the body exerts. In other words, it serves not alone for building and repair, but for fuel as well.

Science teaches us that the energy of the sun which lights and heats this restless planet we inhabit, is stored in wood and coal, petroleum and gas, and is constantly being transformed into the heat of the furnace, the light of the lamp, the power of the steam engine, or into electricity and then into light or heat, or mechanical power again. The same energy from the sun is stored in the protein, the fats, the carbohydrates of the various foods we use, and the physiologists and chemists are to-day telling us how they are transmitted into the heat that warms our bodies, and into the power exerted by muscle, nerve and brain.

If the propositions just stated are correct, *food* may be defined as anything which taken into the body aids in the building of tissues, or in the production of energy.

From this it logically follows that the most healthful foods are those that are best fitted to the wants of the user, and that the best foods are those that are most healthful and most economical.

There is much talk about the relation of diet to health that is equally foolish and hurtful. Foolish because it subverts no good purpose and hurtful because it tends to fortify the pernicious idea that our bodies are in such wretched condition as to need constant tinkering, and that some sort of self-medication is a positive duty. In the place of this wide-spread delusion there should be an inbuilt conviction that there are various products known as foods, in the choice of which, and in the quantity used, each one has daily opportunity to exercise the virtues of common sense and moderation.

One of the most pitiable errors with respect to certain food products is that which somehow confounds them with medicine. For example when one eats freely of fruits he does not feel justified in simply saying he does so because he finds them agreeable, he likes and enjoys them, but is constrained to look wise, and solemnly observe that "fruits are very healthy." Some even go so far as to have for each bodily ailment a different variety of fruit. Let us banish the idea of making a drug-store of our fruit gardens and orchards, and cease looking upon the family fruit dish as a sort of homeopathic pill-box.

Foods are not medicines. A medicine is something which is taken into the body to produce a certain specific and unusual effect, the object being to counteract some injurious tendency, or correct some abnormal condition. If taken when not needed its effect is likely to be directly injurious.

The normally healthy body demands what is *wholesome*, not what is *medicinal*. Anything that has real medicinal value is almost certain to be unwholesome as a general article of diet. We seldom or never acquire an abnormal taste or craving for what is wholesome, but an almost uncontrollable appetite may be developed for what, if properly used may be considered medicinal.

"Blessed are they that hunger and thirst" can be as truly said of our bodily wants as of our spiritual necessities. "Blessed," because hunger and thirst are indicative of health, and when in health the plainest food tastes good and with it we can be "filled." Nothing gives more genuine pleasure than wholesome food and good water to a hungry and thirsty man.

Among the many kinds and classes of wholesome foods, few should rank higher in importance and value than the common fruits from orchards and gardens. In satisfying our natural appetite for fruit, fruit that is well matured, juicy, and fine-flavored, we probably reach the highest form of palate gratification with the least possible digestive effort.

Our ordinary fruits contain eight distinct substances or compounds in greater or less proportions. These are,

1. A large proportion of water: the usual amount ranging from 85 to 90 per cent of the total weight of fresh, well-matured fruit.

2. Sugar in the form of grape and fruit sugar. The percentage is quite variable ranging from about 1.5 per cent in apricots and peaches, to about 12 per cent in some varieties of grapes and cherries. An average well-grown, fully matured apple contains about 8 per cent of sugar.

3. Free organic acids; varying somewhat according to the class of fruit, and usually of several kinds in each class, but altogether forming usually something less than one per cent.

The predominating acid in the apple and pear is malic; in the grape tartaric; and in the orange and lemon citric.

4. Fats, oils and ethers, abundant in some mature fruits, like the olive, occurring in small quantities in others, and in some almost wholly wanting.

5. Protein or nitrogenous compounds, forming a very small proportion of most fruits, often not more than .2 of one per cent.

6. Pectose—a substance which gives firmness to fruit, and which upon boiling yields various fruit jellies. It often forms from three to five or more per cent of the weight.

7. Cellulose and starch, the former often called vegetable fiber is the material that forms the cell walls, and is found in all parts of all plants. It is less abundant in fine fruits than in any other part of plants.

Starch which is found so largely in the cereals, and in certain garden vegetables is almost wholly absent in ripe fruit, being converted into sugar during the process of ripening.

8. A very small percentage of ash or mineral salts.

The substances named above with the possible exception of cellulose are all essential constituents of a perfect or well rounded diet.

The proportion of the more important nutrients, however, are so small that much of our fruit has little direct nutritive value. Suppose we take the three principal groups, viz: carbohydrates, proteids, and fats, which together may justly be called the grand tripod of nutritive substances, and see what some of our representative fruits will furnish. The Horticultural Department of the State University has made quite a number of analyses of the strawberry, and of the substances just named the average results are as follows:

Carbohydrates,	8.0 per cent.
Proteids,	0.3 per cent.
Fats a mere trace, practically nothing.	

It has been estimated by students of dietaries that the minimum daily ration of nutrients for a man of average weight performing an ordinary day's work is:

Carbohydrates,500 grams or 17.8 ounces.
 Proteids,118 grams or 4.2 ounces.
 Fats,56 grams or 2.0 ounces.

Taking the analysis of the strawberry, a simple calculation will show that a person would have to consume 200 ounces or 13 pounds of this fruit daily in order to obtain the requisite amount of carbohydrates from this source, in order to secure the necessary proteids from the same source, a daily consumption of 1,400 ounces or 88 pounds would be required. This would be a task that even those who have the most ardent taste and liking for this fruit could scarcely be prevailed upon to attempt. Even though he should eat the amount named he would still be deficient in approximately all the required fats.

Take another illustration: The nutrients contained in the apple according to analyses that we have made are as follows:

Carbohydrates (including cellulose)10 per cent.
 Proteids2.5 per cent.
 Fats0.2 per cent.

Applying the same calculation as before, we find that one will have to eat 178 ounces, or a little more than 11 pounds of apples a day for the requisite carbohydrates; he would be obliged to eat 168 ounces or $10\frac{1}{2}$ pounds for the necessary proteids, and for the fats it would require 1,000 ounces, or $62\frac{1}{4}$ pounds daily.

This demonstrates that however valuable strawberries and apples may be as a part of an every day diet, they can scarcely be considered as nutrients. In other words their actual nutrient value is exceedingly low.

In order to support life and maintain strength, strawberries and apples like most other fruits must be eaten in connection with more concentrated foods.

Wherein then does the dietetic value of fruit consist? Let us briefly consider. The qualities which render fruits and some of the more delicate garden vegetables wholesome, and cause us to have a natural appetite for, and hence to enjoy them, are their acid juiciness and flavor. The juice is largely water, but it contains the sugar and acid of the fruit, and if these are present in large quantities, and in the right proportion, it is agreeable and refreshing. Most of our food products are valued on the basis of the dry matter they contain. Not so with fruit.

Pure milk is 87 per cent water and may be further diluted

by breed, feed and greed, and its value as food diminished thereby. Many of our fruits contain as much water as average milk, but, as a rule it is the best fruit that contains the most water. I have frequently tested the amount of water in "nubbin" strawberries, "cull" peaches and "runty" apples, and have often found less than 80 per cent.

In the finest specimens of each of these fruits, not overgrown, but perfect samples, that would sell for the very highest price, I have usually found over 90 per cent of water. A heaped bushel of fine large peaches, that contained 100 specimens showed when tested 92 per cent of water, leaving only 8 per cent of solids. This bushel of peaches sold readily at \$3.00. A heaped bushel of small peaches of the same variety, this bushel containing 400 specimens, showed 84 per cent of water, and 16 per cent of dry matter. These were sold with difficulty at 70 cents for the bushel. This shows that the acid juiciness is one of the main factors in the value of fruit. Flavor also adds to the quality of fruit. Flavor is due in part to the organic acids already mentioned, but more largely to certain volatile oils and aromatic ether. It is to these oils and ethers that those delicate characteristic flavors of different varieties of fruit are chiefly due. Chemistry and physiology have taught us that where these "fruity" acids, oils, and ethers are taken into the body, they undergo oxidation, which process tends to lower the temperature of the blood, or at least to modify our temperature sensations, and thus correct or allay any slight feverishness that may exist. They also tend to keep the organs of secretion, the liver, kidneys, etc., as well as the whole digestive tract in a healthy condition. The free acids of fruits, especially citric and malic, are highly antiseptic bodies, and tend to prevent disease germs from finding a lodgment and developing in the body.

In our climate, subject as we often are to rapid changes and extremes of temperature, the physical system is naturally more or less debilitated. In this condition we are predisposed to malaria and other troubles. Fruits and acid vegetables are known to be good correctives for this debilitated condition. We should remember that as a rule, the full beneficial effects of fruit are only to be found in those that are well grown and mature. Green or unripe fruits may have an abundant supply of acids, but such fruits are usually injurious when eaten on account of their indigestibility. This is due partly to the fact that the starch is not yet converted into sugar, and partly, to the coarse and hard condition of the cellulose. When fruits are perfectly developed and properly matured, practically all the starch is converted into sugar, and the cellulose is soft and fine. We know that unripe

fruit is not wholesome. It digests slowly, often ferments in the stomach, and is the cause of painful disorders. It is unwise to take into our stomachs unripe fruit, it is equally unwise to eat that which is over-ripe. The best results from the dietetic use of fruits come from eating those that are fresh, healthy, and well matured.

Fine fruits are the flowers of edible commodities. They please the eye, gratify the taste, and minister to our health. If we appreciated them at their worth, we would use them more freely and our country would be better supplied with this wholesome palatable class of food products.

PAPERS AND ABSTRACTS.

THE CURRENTS IN SANDUSKY BAY.

E. L. MOSELEY.

PURPOSE OF INVESTIGATION.

One who walks or skates much upon the bay cannot fail to have his attention drawn to certain places where the ice never forms or never becomes strong. Some of these weak spots or openings are probably due to the water rising from springs beneath. Others, it seemed to me, might be due to currents of other sorts and suggested an investigation of the currents of the bay. A definite knowledge of the manner in which the inflowing water distributes itself over the bay I thought might also give a clue to the deposition of sand brought in from the lake and so perhaps, at some time in the future be of use in the planning of harbor improvements. The deposition now going on could not be inferred from an examination of the deposits themselves for the entrance to the bay is more than twice as wide as it was three quarters of a century ago and recently its form has been altered by the construction of jetties.

In the course of a discussion at the men's club on the water supply of Sandusky, a prominent citizen stated that there was "a current along the front of the city past the mouths of all the sewers carrying the polluted water right along toward the water-works crib." This afforded another reason for trying to learn something of the movement of the water.

There's a fascination about casting a net upon the waters with the thought that it will return after many days. Moreover many a peasant's boy and many a lone fisherman who seldom receives a communication through the mails is cheered to find one that has drifted to him across the water. He is glad to help in such an investigation, expectant too of some slight reward, and not disappointed when it comes. So that people who question the sanity of a man who does anything unusual, unless it is calculated to put money in his pocket, may at least excuse this craze as a harmless diversion.

METHOD.

Investigation of the currents has been chiefly by means of drifting bottles. Each bottle contained a notice that could be read through the glass, calling attention to the fact that it was

set adrift to show direction of the currents; also a numbered question list, enquiring where and when found, whether still adrift at the time, and the name and address of finder, also a request that the finder mark the place on the map enclosed. To make the bottles more conspicuous, each was fastened to a board about 15x17 centimeters and one centimeter thick, the corners painted orange and at the center a large number in black corresponding to the number on the slip within. The first 26 bottles were so fastened to their boards that they would float alongside, but all after that were weighted with sand so as to make them sink beneath the board and so lessen the direct effect of the wind. All the bottles were heavy and, even when floating, the direct action of the wind upon bottle and board must have been relatively small as compared with the effect of the water, except when the latter was nearly at rest. Most of the bottles, when immersed, displaced about 700 c.c. of water. The wire was so adjusted as to bring the bottom of the bottle about a foot below the surface.

RESULTS.

I have found no evidence of a persistent current carrying the sewage to the waterworks crib. I have found no evidence of a persistent current anywhere. Eighty bottles were set adrift between July 26 and December 6, 1902. Before the freezing of the bay in December, 44 had been found and reported. A few others will probably be heard from in 1903.

Two bottles thrown off the Cedar Point boats when about 228 rods from the Cedar Point dock, one August 1, the other August 8, were both found near No. 10 culvert east of the stand-pipe. Bottles were set adrift at this place at four other times. Only one has been heard from; it had gone in a direction nearly opposite to the others. In no other case have two bottles set adrift at the same place on different days been found in the same place, but in several cases they have been found in quite different directions from the starting point. In all cases (29 in number) in which the bottles were found within four days after being put in, the course they took can be readily accounted for. So closely dependent is the course upon the direction and velocity of the wind for some time before and after the bottle is put in that one would not require a very long experience to predict from the wind record approximately the course the bottle would take. The bottle, however, might not be found until it had changed or even reversed its course. The bottle may go against the wind or make a large angle with it. If the wind is strong, the bottle usually goes in the same general direction. So long as it re-

mains in the bay, its course depends largely upon whether the water is rising or falling. This in turn depends mainly on the wind. If for several days the wind does not vary much in velocity or direction, the level of the bay adjusts itself to it and no marked change of level will occur until the wind lessens or increases in force or changes in direction. If strong westerly winds have prevailed for some time and within 24 hours change to east or northeast, a strong current sets into the bay, while a reverse change of the wind will cause a strong current outward. At any point in the bay the current depends partly on the position with reference to shores or shoals, partly on the direct action of the wind on the water in that part of the bay, but chiefly on whether at the entrance to the bay the water is entering or leaving. These three factors affect both the direction and velocity of the current.

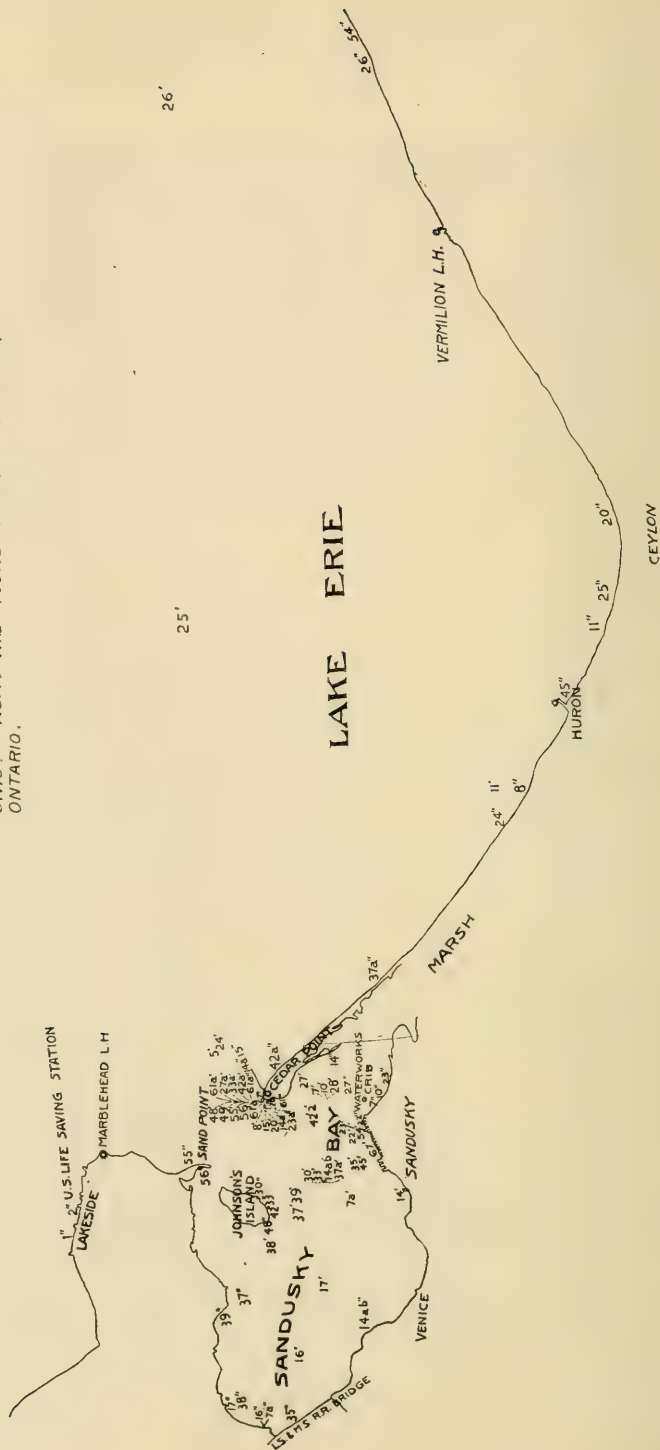
EXAMPLES.

Bottle No. 14ab was set adrift October 25 at 9:30 a. m. half way between the foot of Columbus avenue and the west end of Johnson's Island. It was found the same day at 4 p. m. lying on the beach one and one-third miles west of Venice—more than three miles in a straight line from its starting point. The day before, the wind had been fresh from the southwest. On the 25th it was fresh from the northeast. Bottle No. 37a, started from the same place September 27 at 1 p. m., was found the next morning at nine o'clock broken and among timbers on the lake side of Cedar Point about three miles from the light-house. On the 24th and 25th the prevailing direction of the wind was from the east with maximum velocities of 21 and 18 miles. On the 26th it was light and mainly south, but on the 27th, the day the bottle was put in, it became southwest, blowing at one time 22 miles from the west and in the night 30 miles from the west. This carried the bottle into the lake and then the wind, becoming light without much change of direction, caused the water to set back and cast the bottle ashore on the east side of the Point.

Four bottles were thrown off the end of the Short Line dock. Only one has been heard from. It was found on the sand bar that separates Biemiller's Cove from the bay about three fourths of a mile from the Cedar Point dock and three miles from its starting point. It had drifted this distance between 6:55 P. M. August 10 and 1:30 P. M. August 11. On the 9th the wind was east but on the 10th it changed to south, southwest and west causing a current that carried the bottle out into the bay and then toward the entrance. On the 11th it blew from the west and later from the northwest with the maximum velocity



CHART SHOWING BEGINNING (MARKED ')
AND END (MARKED") OF BOTTLES' COURSES
NO. 234 WAS FOUND NEAR WILLOUGHBY LAKE CO.,
OHIO. NO. 49 WAS FOUND AT PORT GLASGOW,
ONTARIO.



for the month, so that, instead of going out of the bay, it was driven toward the southeast.

On August 22, three bottles were thrown off the Steamer Lakeside, along the route to Cleveland. The wind was northerly. All three were found on the beach within nine miles of the places where they were set adrift, two of them August 23 the other August 24.

Quite a number of bottles were set adrift at the entrance to the bay when the current was coming in but a number of these and also of bottles thrown into the bay in other places were found on the shores of the lake. This is not due in any large measure to more water going out than coming in but to the fact that the lake is so large that the chance of their being brought to the mouth of the bay again if they once get into the lake is very small. Bottle No. 61 a, with a five foot wire, was put adrift at the Sandusky Bay Front Light, Inner Range, by the light-keeper, Frank Ritter, November 12 at 4 P. M., and its board watched as long as it could be seen, i. e. till it had drifted into the bay about a quarter of a mile. In the night it came back to him and he found it at daybreak close to the light station, the bottle resting on the bottom, its board still at the surface.

Some of the bottles drifted from Sandusky Bay to Lakeside, to Kelley's Island, to the vicinity of Huron and Ceylon, one in the course of 15 days to near the mouth of the Chagrin River, 75 miles away, one in 35 days to Port Glasgow, Ontario, more than one hundred miles.

CURRENTS AT DIFFERENT DEPTHS.

On three occasions Mr. Ritter has set adrift at the entrance to the bay three bottles at a time, one with a five foot wire, one with three and one with one foot, watching them with glasses as long as visible. In the first case the deepest bottle went in the same direction as the other two—west—but only about half as fast, the one and three foot bottles keeping together. The wind that day was fresh from the northeast, having been the day before fresh from the southwest. In the second case all drifted in the same direction—west—but the one nearest to the surface lagged behind the other two which kept together. The wind at that time was very light from the southeast and the incoming current was due mainly to a difference of level, caused by winds from other directions for some time before. In the third case all drifted southwest, the one nearest the surface taking the lead, the deepest one in the rear. The wind had been from the southwest for several days but diminished in velocity about ten hours before the bottles were thrown in.

Other trials at this place would probably show that currents at different depths sometimes go in different directions. An opposite current at the surface and near the bottom has been observed in the Black Channel by Ralph Scherz.

RAPID CURRENTS.

Several of the examples cited above show currents of much more than average velocity. Since the opening has been narrowed by jetties the current is at times so strong as to make it difficult for tugs to pull vessels into or out of the bay.

The rapidity with which sewage may be carried out of the bay under favorable conditions is shown by bottle No. 67, thrown off the end of the dock of the Sandusky Lumber and Box company, December 5 at sunset, and found at sunrise December 6, by Mr. Ritter close to the south side of his light station at the entrance to the bay. North and northeast winds with maximum velocity of 22 miles had blown since early morning of the preceding day raising the level of the bay, but the wind became light the afternoon the bottle was thrown in and changed to southwest soon after, blowing light from the southwest or south all night, and giving opportunity for the flood to subside.

Brisk southwest winds often lower the water in the bay as much as two feet, and brisk northeast winds raise it that much above the usual level. Assuming the average depth of the entire bay to be nine feet, a southwest wind will reduce it to seven feet. A northeast wind following this may raise the level to eleven feet and so bring into the bay from the lake more than half as much water as the bay contained a few hours before.

THE METEOR OF SEPTEMBER 15, 1902.

E. L. MOSELEY.

(Abstract.)

At about 5:40 a. m., Washington time, a meteor entered the earth's atmosphere, probably over West Virginia, and traveled north at least three hundred miles, leaving behind a luminous train that remained visible until it faded out in the light of dawn. Over Ohio its elevation was very great, and most observers heard no sound, but at London, Ontario, the detonations and reports were very loud and sounded like distant cannon.

I am still collecting data regarding it and would be thankful for a communication from any one who had a good view of it, and especially for a careful estimate of its minimum zenith distance.

ADDITIONS AND CORRECTIONS TO THE SANDUSKY FLORA.

E. L. MOSELEY.

(Abstract.)

Quercus prinus, page 73, *Salix alba caerulea*, page 70, and *Cyperus refractus*, page 58, should be stricken from the list. Specimens from the oak in Judge Mackey's yard, Sandusky, were sent to eminent botanists and pronounced to belong to three species. I now believe it to be *Quercus bicolor*. The additions to the Flora will not be published until after another season's collecting.

A NOTE ON THE SIGNIFICANCE OF THE SIZE OF NERVE FIBERS IN FISHES.

C. JUDSON HERRICK.

(Abstract.)

Each functional system of peripheral nerves has tolerably definite fiber characteristics, the basis for which is as yet unknown. These characteristics are by no means invariable, but the fibers of a given system may show considerable differences in caliber and medullation in a single animal. Some of these differences, at least, may be correlated with the degree of functional development of the peripheral end-organ. In general, highly developed muscle fibers, sense organs, etc., receive larger nerve fibers than similar organs in a state of structural and functional degradation. This paper appears in *The Journal of Comparative Neurology* 12: No 4, Dec., 1902.

OHIO STATIONS FOR MYRIOSTOMA.

JOHN H. SCHAFFNER.

This paper is published in the *Journal of Mycology* 8: 173-1902. *Myriostoma* occurs on Cedar Point and Green Island.

PRELIMINARY REPORT ON THE PLANT ECOLOGY OF BRUSH LAKE.

JOHN H. SCHAFFNER.

A general description was given of the vegetation in and about the lake and of the ecological factors which determine the arrangement of the various plant societies. The work will be carried on for another year.

THE FLORA OF LITTLE CHICKEN ISLAND.

JOHN H. SCHAFFNER.

This paper appears in the Ohio Naturalist 3: 331. 1902.
Fifteen species of seed plants were found on the island.

SOME ALGAE FROM SANDUSKY BAY.

LUMINA C. RIDDLE.

This paper is published in the Ohio Naturalist: 3: 317-319.
1902. Seventy species are listed of which forty-four are new to
the state list.

NEW HELICONIAS FROM GUATEMALA AND
ELSEWHERE.

ROBERT F. GRIGGS.

(Abstract.)

Because of the climate and other difficulties many of the groups of tropical plants have been neglected and are almost unknown. It is almost impossible to make good specimens of Heliconias in the moist regions where they grow. Specimens when made are of little value as they are fragmentary and colorless. They have never been studied specially in the field and hence there is much to learn about them. On account of unusual opportunities for collecting and study the writer has been able to discover and describe seven new species from Guatemala and one from Porto Rico. The closeness of one of the Guatemalan species to *H. bihai* necessitated the revision of that species. It was found to be a composite to which plants of at least three types and four species had been referred. This paper will be published in full elsewhere.

THREE INTERESTING TROPICAL PLANTS.

ROBERT F. GRIGGS.

(Abstract.)

The first of these is a species of *Physalis* with flowers only 2 mm. in diameter — so small that they had been entirely overlooked by everyone who has examined it during the ten years it has lain in the National Herbarium.

The second is a *Curatella* from Guatemala which is remarkable for the very large deposit of silica in the leaves so that it is used as sandpaper by the natives.

The third is an *Amphitecna*, a genus which has never before been studied in the field and whose fruit has never been described. The fruit is interesting as it is strikingly similar to a cacao pod, hanging down from the main trunk like cacao.

AN ECOLOGICAL STUDY OF WEST MANSFIELD SWAMP.

(*Preliminary Report.*)

W. A. KELLERMAN.

General description of the area, principal plants, and photographic illustrations — indicating the extent and character of the work done to date, with plan for more extended researches.

THE THREE FORMS OF PRICKLY LETTUCE IN OHIO.

W. A. KELLERMAN.

(Abstract.)

Distribution in Ohio noted of *Lactuca scariola*, *Lactuca virosa* and *Lactuca saligna*. Attention was called to the judgment on those forms by Dr. B. L. Robinson, who regards the one called by Dr. N. L. Britton "*Lactuca virosa*," as a variety (*integrata*) of *Lactuca scariola*. Careful search for intermediate characters, especially in the shape of the leaves, among many thousands of plants growing in the vicinity of Columbus, or collected elsewhere in Ohio, was not rewarded with success.

TWO BOTANIZING TRIPS IN THE MOUNTAINS OF WEST VIRGINIA.

W. A. KELLERMAN.

The general character of the vegetation and the peculiar and characteristic forms observed in the Gauley River and Gauley Mountain region, and also in the upper portion of the Greenbrier River region; with brief account of rare and interesting plants of the Cheat Mountains near Cheat Bridge (Winchester). *Abies fraseri* and *Celtis mississippiensis*, also several new species of fungi were reported new to the listed flora of West Virginia.

THE LIFE HISTORY PROBLEM OF THE HETEROECIOUS RUSTS.

W. A. KELLERMAN.

Brief historical and biologic account with outline of culture experiments — the latter is published in the *Journal of Mycology*, February, 1903.

THE OHIO ERYSIPTHACEAE — KEYS AND DISTRIBUTION.

W. A. KELLERMAN AND J. G. SANDERS.

The keys are arranged for easy determination of the Ohio species and the list is based on the specimens in the Ohio State Herbarium.

ANNUAL REPORT ON THE STATE HERBARIUM AND PLANTS NEW TO THE STATE LIST.

W. A. KELLERMAN.

The additions to the State Herbarium since my last annual report was made, are in number 3,622 mounted sheets. For the most part the specimens are ample and of good quality. In this work 69 persons joined, each one contributing at least one specimen, many two or three dozen, or even one or two hundred, and in one case 1,277 specimens. The contributors are named below with the number of specimens contributed.

Aiken, Walter H.....	10	Horlacher, S. E.....	20
Bonser, Thomas.....	112	Hyde, Earl.....	15
Brockett, Ruth E.....	14	Ingold, C. P.....	10
Burglehaus, F. H.....	207	James, J. F.....	3
Burr, Mrs. E. W.....	1	Jennings, Otto E.....	120
Case, Mrs. T. W.....	67	Kellerman, W. A.....	1,277
Coberly, E. D.....	30	Kellerman, W. A. and Mrs.	4
Coberly, E. D. and Long, J.		Kellerman, W. A. and	
Paul.....	91	Beattie, W. R.....	14
Crowner, Mrs. F. G.....	2	Kellerman, W. A. and	
Drushel, J. A.....	18	Fullmer, E. L.....	6
French, Mrs. J. M.....	1	Kellerman, W. A. and	
Fullmer, E. L.....	18	Griggs, R. F.....	30
Gould, D. T.....	3	Kellerman, W. A. and	
Hacker, Otto.....	127	K. F.....	21
Hard, M. E.....	2	Kellerman, W. A. and	
Hayes, Rutherford P.....	1	K. F. and Beattie, W. R.	6
Herrick, Ethel.....	1	Kellerman, W. A. and	
Herzer, Rev. H.....	102	K. F. and Jones, Victor.	11
Hopkins, L. S.....	74	Kellerman, W. A. and	

Tyler, F. J.....	12	Siders, Grace.....	24
Krebs, William.....	1	Spurlock, T. W.....	1
Lagelman, J. H.....	11	Stockberger, W. W.....	61
Lind, G. D.....	1	Tangeman, Clara M.....	6
Louth, E. V.....	10	Thomas, F. E.....	3
McCall, Arthur G.....	2	Tyler, F. J.....	177
Mertz, H. N.....	2	Tyler, F. J. and Jennings,	
Minor, C. A.....	4	O. E.....	9
Moseley, E. L.....	9	Vandervoort, J. S.....	4
Nettleton, A. W.....	1	Watson, J. R.....	4
Norman, L. N.....	40	Webb, R. J.....	2
Ohio Experiment Station..	543	Werner, W. C.....	3
Osburn, R. C.....	8	Wetzstein, A.....	71
Palmer, R. J.....	8	Wilcox, E. M.....	1
Ricksecker, A. E.....	2	Williamson, E. B.....	1
Riddle, Lumina C.....	18	Winkler, H. S.....	4
Rood, A. N.....	10	Woodworth, May.....	1
Sanford, J. A.....	1	Young, W. U.....	1
Schaffner, John H.....	5		
Sharp, Mrs. K. D.....	71	Total	3,622

The number of specimens in the State Herbarium reported one year ago was 15,597, and the addition of was 3,622 the past year. Therefore there are incorporated, and available for consultation, in the Herbarium 19,219 mounted sheets. The species not hitherto reported in the State Catalogue of plants, nor given in previous Annual Reports of the Ohio State Academy of Science are named below. This list was published under a systematic arrangement in a University Bulletin (May, 1902), but is here given in a more convenient form for consultation:

- Acnida tamariscina* prostrata Uline and Bray. Prostrate Water Hemp. Painesville, Lake County. Otto Hacker.
- Acuan illinoensis* (Mx.) Kuntze. (*Desmanthus brachylobus* Benth.) Illinois Mimosa. New Richmond, Clermont County. A. D. Selby.
- Agrimonia brittoniana* Bick. Britton's Agrimony. Farmer's Station, Clinton County. C. R. Ingold.
- Agrimonia pumila* Muhl. Small Fruit Agrimony. Huron County. Otto E. Jennings.
- Aira caryophyllea* L. Silvery Hair-grass. Rarely escaped. Painesville, Lake County. Otto Hacker.
- Apera spica-venti* (L.) Beauv. Silky Bent-grass. Wildstraw. Painesville, Lake County. Otto Hacker.
- Arnoseris minima* (L.) Dumort. Lamb Succory. Painesville, Lake County. Otto Hacker.
- Asperugo procumbens* L. German Madwort. Catchweed. Painesville, Lake County. Otto Hacker.
- Asperula hexaphylla* All. *Asperula*. Escaped. Painesville, Lake County. Otto Hacker.

- Botrychium lunaria*. (L.) Sw. Moonwort. Painesville, Lake County. Otto Hacker.
- Brassica oleracea* L. Cabbage. Preble County. W. A. Kellerman.
- Camelina microcarpa* Andr. Small-fruited False-flax. Painesville, Lake County. Otto Hacker.
- Chaerophyllum procumbens shortii* T. & G. Short's Chervil. Clermont County and Butler County. J. F. James; Hamilton County. C. J. Herrick.
- Coronilla varia* L. Coronilla, Axseed, Axwort. Painesville, Lake County. Otto Hacker.
- Crassina elegans* (Jacq.) Kuntze. (*Zinnia elegans* Jacq.) *Zinnia*. Escaped. Gallia County. W. A. Kellerman.
- Crocus vernus* All. Crocus. Escaped. Painesville, Lake County. Otto Hacker.
- Datura metel* L. Entire-leaf Thorn-apple. Escaped. Painesville, Lake County. Otto Hacker.
- Diodia teres* Walt. Rough Buttonweed. Painesville, Lake County. Otto Hacker.
- Euonymus europaeus* L. Spindle-tree. Escaped. Painesville, Lake County. Otto Hacker.
- Euphorbia cuphosperma* (Engelm.) Boiss. Warty Spurge. Painesville, Lake County. Otto Hacker.
- Festuca myuros* L. Rat's-tail Fescue-grass. Painesville, Lake County. Otto Hacker.
- Fumaria parviflora* Lam. Small Fumitory. Painesville, Lake County. Otto Hacker.
- Galinsoga parviflora hispida* D. C. Hispid Galinsoga. Painesville, Lake County. Otto Hacker.
- Gemmingia chinensis* (L.) Kuntze. Blackberry Lily. Escaped. Franklin County. J. H. Schaffner.
- Gentiana flavida* A. Gr. Yellow Gentian. Lucas County. F. H. Burglehaus.
- Hieracium pilosella* L. Mouse-ear Hawkweed. Painesville, Lake County. Otto Hacker.
- Hordeum distichum* L. Two-row Barley. Rarely escaped. Painesville, Lake County. Otto Hacker.
- Hordeum sativum* Jessen. Common Barley. Occasionally escaped.
- Hypochaeris glabra* L. Smooth Cat's-car. Painesville, Lake County. Otto Hacker.
- Hypochaeris radicata* L. Long-rooted Cat's-car. Painesville, Lake County. Otto Hacker.
- Humulus japonicus* Sieb. & Zucc. Japan Hop. Escaped. Toledo, Lucas County. F. H. Burglehaus.

- Kickxia spura* (L.) Dumort. (*Elatinoides spuria* Wetzst.)
Painesville, Lake County. Otto Hacker.
- Kneiffia linearis* (Mx.) Spach. Narrow-leaf Sundrops. Painesville, Lake County. Otto Hacker.
- Lactuca virosa* L. Strong-scented Lettuce. Confused with *L. scariola* according to Britton, being the commoner of the two species. (A. D. Selby, Meeting of Ohio Academy of Science. November, 1901.)
- Lemna cyclostasa* (Ell.) Chev. (*L. valdiviana* Phil.) Valdivia Duckweed. Richmond, Lake County. Otto Hacker.
- Lepidium draba* L. Hoary Cress. Lucas County. F. H. Burglehaus.
- Linnorchis hyperborea* (L.) Rybd. (*Habernaria hyperborea* (L.) R. Br.) Canton. Mrs Theano W. Case.
- Linum perenne* L. Perennial Flax. Painesville, Lake County. Otto Hacker.
- Lychnis viscaria* L. Lychnis. Escaped. Painesville, Lake County. Otto Hacker.
- Mentha Longifolia* (L.) Huds. Horse Mint. Painesville, Lake County. Otto Hacker.
- Mercurialis annua* L. Mercury Plant. Painesville, Lake County. Otto Hacker.
- Monarda mollis* L. Canescent Wild Bergamot. Erie County. W. A. Kellerman and F. J. Tyler; Cuyahoga County. J. R. Watson.
- Myagrurn perfoliatum* L. Myagrurn. Painesville, Lake County. Otto Hacker.
- Physalis francheti* Mast. Chinese Lantern Plant. Escaped. Lake County. Otto Hacker and D. W. Talcott.
- Pinus echinata* Mill. Yellow Pine, Spruce Pine. Auglaize County. A. Wetzstein.
- Poa nemoralis* L. Wood Speargrass. Lake County. Otto Hacker.
- Polygonum punctatum robustior* Small. Water Smartweed. Painesville, Lake County. Otto Hacker.
- Portulaca grandiflora* Hook. Garden Portulaca. Sun Plant. Escaped; roadsides. St. Mary's, Auglaize County. A. Wetzstein.
- Potamogeton heterophyllus myriophyllus* (Robbins) Morong. Many-leaf Pondweed. Stark County. W. A. and K. F. Kellerman.
- Potentilla pumila* Poir. Dwarf Five-finger. Painesville, Lake County. Otto Hacker.
- Prunus mahaleb* L. Mahaleb. Perfumed Cherry. Columbus, Franklin County. W. A. Kellerman; Painesville, Lake County. Otto Hacker.

- Quercus alexanderi* Britton, Alexander's oak, "Ohio." N. L. Britton Manual, 336. This was formerly confused with, or included in *Q. acuminata*, and like the latter is not uncommon in Ohio.
- Ribes uva-crispa* L. Garden Gooseberry, escaped. Ironton, Lawrence County, and Columbus, Franklin County. W. C. Werner.
- Rosa gallica* L. French Rose. Escaped. Painesville, Lake County. Otto Hacker.
- Rosa nitida* Willd. Northeastern Rose. Painesville, Lake County. Otto Hacker.
- Rubus canadensis* L. (*R. millspaughii* Britt.) Millspaugh's Blackberry. Ash Cave, Hocking County. W. A. and K. F. Kellerman.
- Rubus neglectus* Peck. Purple Wild Raspberry. Painesville, Lake County. Otto Hacker.
- Rubus phoenicolasius* Maxim. Japan Wineberry. Escaped from cultivation; comes freely from seed, and propagates by tips. Painesville, Lake County. Otto Hacker.
- Salvia lanceolata* Willd. Lance-leaf Sage. By roadside near Columbus. W. A. Kellerman.
- Scleranthus annuus* L. Knawel. German Knotgrass. Painesville, Lake County. Otto Hacker.
- Scutellaria parvula ambigua* Fernald. "Ohio," Nuttall; Greene County. E. L. Mosely; Montgomery County. W. U. Young; Franklin County. E. E. Bogue; Gallia County, J. W. Davis.
- Selaginella apus* (L.) Spring. Creeping Selaginella. Perry, Lake County. Otto Hacker.
- Silene antirrhina divaricata* Robinson. Spreading Catchfly. Gallia County. W. A. Kellerman.
- Sisymbrium altissimum* L. Tall Sisymbrium. L. D. Stair in List of Railroad Weeds. Painesville, Lake County. Otto Hacker; Preble County. W. A. Kellerman.
- Solidago erecta* Pursh. Slender Goldenrod. Ash Cave and Goodhope Township, Hocking County. Pomeroy, Meigs County. W. A. Kellerman.
- Sorbus aucuparia* L. European Mountain Ash. Escaped. Painesville, Lake County. Otto Hacker.
- Spigelia marylandica* L. Indian Pink or Carolina Pink. Fl. M. V. A. P. Morgan; North Madison, Lake County. D. W. Talcott; Painesville, Lake County. Otto Hacker.
- Tanacetum vulgare crispum* D. C. Tansy. Painesville, Lake County. Otto Hacker.

- Trifolium dubium* Sibth. Least Hop-clover. Painesville, Lake County. Otto Hacker.
- Urtica urens* L. Small Nettle. Painesville, Lake County. Otto Hacker.
- Valeriana officinalis* L. Garden Valerian. Escaped. Painesville, Lake County. Otto Hacker.
- Veronica chamaedris* L. Germander Speedwell. Painesville, Lake County. Otto Hacker.
- Viburnum lantana* L. Wayfaring Tree. Escaped. Painesville, Lake County. Otto Hacker.
- Vicia angustifolia* Roth. Smaller Common Vetch. Painesville, Lake County. Otto Hacker.
- Viola emarginata* (Nutt.) LeConte. Painesville, Lake County. Otto Hacker.
- Viola odorata* L. English or Sweet Violet. Escaped Painesville, Lake County. Otto Hacker.
- Viola palmata sororia* (Willd.) Poll. Bowling Green, Wood County. W. A. Kellerman.

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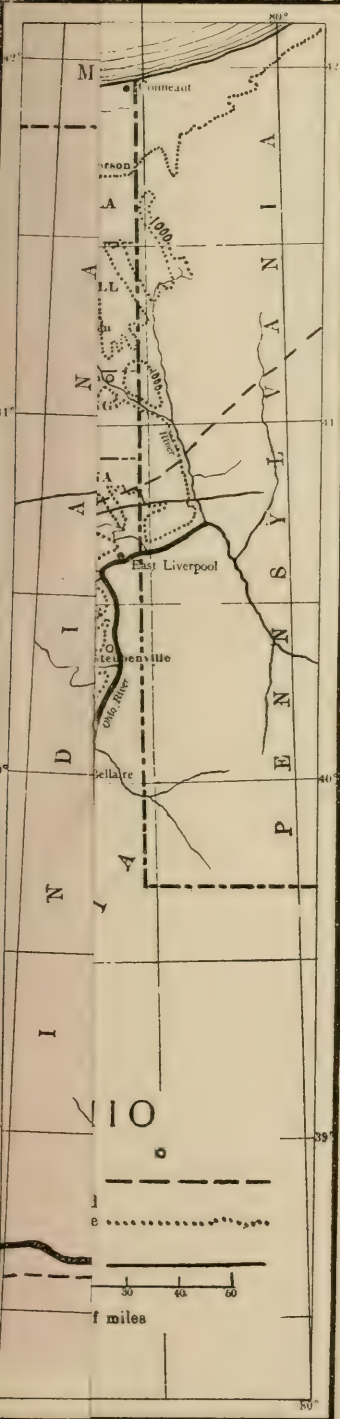
A REVISED CATALOGUE

BY

LYNDS JONES, M. Sc.

Published by the Academy of Science with the
Emerson McMillin Research Fund

OCTOBER, 1903



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Publication Committee :

J. H. SCHAFFNER, L. H. MCFADDEN, GERARD FOWKE

OCTOBER 15, 1903

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WILLIAM R. LAZENBY.

F. M. WEBSTER,

JOHN H. SCHAFFNER,

Trustees.

PREFACE.

Dr. J. M. Wheaton transmitted his monumental "Report on the Birds of Ohio" to Prof. J. S. Newberry, Chief Geologist of Ohio, on November 1, 1879. It was finally printed by the state and distributed in 1882. One year later, at the first Congress of American Ornithologists' Union, held in New York, September 26-29, 1883, a committee was appointed to whom was referred the question of revising the classification and nomenclature of the Birds of North America. That committee's work was completed, accepted, and the results printed in a Check-List* early in 1886. Until the publication of this Check-List there had been no uniformity in the nomenclature of birds, each author practically building his own system. Dr. Wheaton adopted, in a somewhat modified form, "The nomenclature of Dr. (Elliot E.) Coues in his Check-List of North American Birds," published in 1874. That system followed the customs of the time by beginning with the highest and ending with the lowest forms. The nomenclature adopted by the committee of the American Ornithologists' Union* turned the old system about, beginning with the lowest and ending with the highest forms, as they were then regarded. Seven years after the completion of his work and four years after its publication, therefore, the nomenclature of Dr. Wheaton became obsolete, for the new nomenclature found immediate acceptance the country over, and has since been the working basis of all American Ornithologists.

The need of a Revised Catalogue of the Birds of Ohio has been sorely felt, chiefly that the nomenclature might be uniform with that of all more recent publications on Ornithology. The score of years which have elapsed since Dr. Wheaton's Catalogue was issued have seen other changes

*The A. O. U. Check-List of North American Birds, for sale by L. S. Foster, 30 Pine street, New York City.

as well as those of nomenclature, making the call for a revision all the more imperative. The changes in the physical features incident to the fuller settlement of the state have been attended by changes in the whole fauna, the bird population changing with the rest.

Keenly feeling the need for a state catalogue of our birds which should embody the latest results of field work and conform to the adopted system of nomenclature, the writer appealed to the Ohio State Academy of Science, at its meeting in December, 1900, and found ready sympathy in the plan for a revision. A liberal portion of the McMillin fund was placed at his disposal for the purpose of prosecuting the work, and it is largely that substantial help which makes it possible to present the finished report at this early date. With this fund it was possible to mail upward of two hundred lists of birds of probable occurrence to different parts of the state for reports from local bird students, and to visit several little known regions of the state for the purpose of studying the bird fauna there at first hand. A list of those who kindly contributed notes and who gave other assistance will be found elsewhere.

The nomenclature adopted in this Catalogue conforms to that of the American Ornithologists' Union Check-List, Second Edition and Supplements succeeding. While this system is not free from faults, and while another revision seems imminent, it is not within the province of this catalogue to anticipate much of such revision. Some questions relating to the validity of species and subspecies which occur in Ohio await settlement. In these few cases I have been obliged to use my best judgment respecting the questions at issue. If that judgment proves unsound I trust that the reader will consider the limitations of time and material under which I am obliged to complete this work.

INTRODUCTION.

SCOPE.

This is not a treatise on descriptive ornithology. The reader who turns to the list of species expecting to learn the color patterns and other characteristics of the several species treated within these covers will be disappointed. Books upon descriptive ornithology are both so numerous and so readily accessible now that it is no longer the province of faunal lists and catalogues to describe birds; they should rather endeavor to contribute to our knowledge of the habits and economic relations. There are added reasons why this catalogue should not attempt to describe the species enumerated. In 1903, there will be ready for distribution a popular scientific work upon the "Birds of Ohio."* This book will be based upon this catalogue, and is being prepared by my friend and colaborer, Rev. William Leon Dawson, of Columbus.

This catalogue is a revision of Dr. J. M. Wheaton's catalogue issued in 1882 as a part of Volume IV of the Ohio Geological Survey. An attempt has been made to draw comparisons between the conditions prevailing then and now, especially as regards the bird life, and to add such facts as further study and improved methods have brought to light. I have not deemed it advisable to reprint much of Dr. Wheaton's catalogue, because a considerable number of copies of that important work may be secured from Mrs. Wheaton, who still resides in Columbus.

*"The Birds of Ohio." A complete, scientific and popular description of the species of birds found in the state. By William Leon Dawson, B.D., with introduction and analytical keys by Lynds Jones, S.M., Instructor in Oberlin College. Illustrated by 80 plates in color-photography, and more than 200 original half-tones, showing the favorite haunts of the birds, flocking, feeding, nesting, etc., from photographs taken by the author and others. Sold only by subscription by The Wheaton Publishing Co., Columbus, Ohio.

THE TASK.

The task of revision involves far more than merely a rearrangement of the groups and species to conform to the present accepted alignment. Many names have been changed wholly or in part, species have been divided into two or more forms, the status of each of which must be determined where they affect Ohio birds. There have been changes in the distribution of some species in the state. Questions of the validity of records of species occurring in Ohio, old as well as new, have presented themselves. The influences of more complete settlement have needed attention. Twice as much time as has been allotted me for this task could have been used profitably, but it is hoped that some worthy results are here presented.

THE PLAN.

While Dr. Wheaton used a somewhat modified form of Dr. Elliot Coues' system of 1874, the present catalogue conforms pretty strictly to the nomenclature and arrangement of the American Ornithologists' Union, revised to date.

The scientific names, with the authority for them, as well as the English names, conform to the above-named Check-List. Under the caption "Synonyms" are given first, the scientific, and second, the English names which have been used to designate the species in other works, the names used by Dr. Wheaton in his 1882 catalogue being given preference where they differ from the present names.

BIBLIOGRAPHY.

Under the caption "Bibliography" only the first published reference to the species as occurring in Ohio is given. While the author has endeavored to verify all references and make certain of accuracy here, his limited reference library must account for inaccuracies. The bibliography of Ohio birds is less extensive than that of many other states, but it is scattered over many minor publications which are difficult to secure. In the appendix will be found as complete a bibliography as the writer has been able to compile after much

patient search. Additions to this list would be gladly received.

RELATIVE ABUNDANCE.

In speaking of the relative abundance in Ohio of the several species of this catalogue I have made use of the more than threescore reports contributed by bird students scattered over most of the state. None of these reports give evidence of any more system in determining the relative abundance than Dr. Wheaton's and his colaborers' work shows, hence the comparisons drawn will seem fair. It is to be hoped that some system for the determination of the relative abundance of birds may soon be brought forward; until that is done we cannot hope for accurate results in this field of knowledge. Dr. Wheaton's observations and those of the persons on whom he relied for information covered only a small fraction of the state, to be sure, but the regions covered may be assumed to have been representative of most of the state at least. It will appear in the discussion of this interesting subject that the author has often quoted himself without the mention of others. Where that is the case the reports received from observers have been too conflicting to be of use, and he has been driven from the unknown to the known. The necessary differences prevailing among bird students as regards the time spent in study, the time of day when the observations are made and the topography covered, furnish no means of comparison unless these elements are known. Field work done at noon only will fail to discover such birds as are quiet during that time. Field work which does not cover certain regions will result in omitting such species as resort only to such regions. Unfamiliarity with notes and songs will often result in the failure to discover certain secretive species, or will fail to notice more than a few where there may be great numbers. Thus it is that only where pretty general agreement obtains, or where there is an evident gradation from one region to another at some distance, that these reports can be wholly relied upon. This does not mean that the accuracy of any ob-

server is questioned, but it only indicates my own ignorance of the conditions under which he worked.

DEFINITION OF TERMS USED TO INDICATE RELATIVE ABUNDANCE.

Lack of any system for indicating what is meant by the terms "Abundant," "Common," "Tolerably Common," "Rare," and "Casual," makes it necessary for each person using them to define his own system. The terms "Accidental," "Hypothetical," and "Introduced," are defined where they are used, after the treatment of the species in the body of the catalogue.

In a general way, the term "Abundant" signifies that the species to which it is applied are so numerous in individuals as to force themselves upon one's notice. The English Sparrow is the only bird to which this term can be applied the year through. A number of species may be abundant at certain times, as the Robin, Vesper Sparrow, Meadowlark, Wood Pewee, and Bronzed Grackle. These and others may be abundant in certain regions and not in others; or in certain restricted localities and either less numerous or even almost wholly absent from other localities near.

A species is regarded as "Common" when a considerable number of individuals may be found without much effort or much expenditure of time. In the use of this term account must always be taken of the habits of the species to which it is applied. Thus, the Oven-bird may properly be entered as common in a region if it be remembered that it is strictly a woods bird. "Common in woods" would be the accurate designation.

"Tolerably Common" is used to indicate the fact that the individuals of the species designated are so few that they must be searched for under normal conditions, and yet present in the region. The Blue-gray Gnatcatcher is a fair example in all parts of the state which I have visited.

"Rare" is the term reserved for a species which is represented by so few individuals that a record of its occurrence is regarded as unusual. In Lorain county the Golden Eagle

is rare, because one or two records of its appearance in a year is all my books show.

"Casual," as used in this catalogue, means that the species to which it is applied visits the state only under unusual circumstances. Thus, the Great Gray Owl could not be expected to reach Ohio except during an unusually severe winter when its food supply north failed. Casual stands close to accidental. A Red-tailed Hawk would be casual in a small city park, because that park lies within its range in the surrounding region. A Bullock Oriole would be accidental there because its home is in regions far removed.

In the use of any of these terms except "Casual," account must be taken of the habits of the birds. The Red-winged Blackbird may be abundant in the marshes of any county, but practically absent from the rest of that county. In the body of the work I have endeavored to indicate what are the regions preferred by the different species. Account must also be taken of the size of the birds to which the terms are applied in each instance. Thus a dozen Red-tailed Hawks in a township would make that hawk appear almost abundant, while a dozen Chipping Sparrows or Robins in that same township would be almost rare for the species.

Some prophet must arise who will be able to develop a system of relative terms for general use. Such a system is greatly needed in the further development of the department of field ornithology.

BREEDING.

Not the least difficult of the problems presenting themselves for solution has been that relating to the breeding of many species within the state. So little was known of the general breeding range of many species when Dr. Wheaton completed his work, that it is not strange that he should have regarded as "probably breeding in the northern parts of the state" several species whose breeding range lies well to the north. It is also more than probable that several species which remained to breed before the state became

so well settled, no longer do so. Remembering the almost total lack of information regarding the southward migrations of many species at that time, we can readily understand how even such keen observers as Drs. Wheaton and Kirtland should have been led to regard as breeding within the state some species which were found in late July. Now we know that they are the vanguard of the southward moving host. We also know that the presence of individuals of a species in summer is not *prima facie* evidence of its breeding, because many unmated birds wander about considerably, and wounded water-birds may be unable to complete their journey and yet be unable to breed where they are obliged to remain. Nor does the author regard the presence of young which the parent or parents are still feeding positive evidence of breeding, if the occurrence lies close to the state border, because it is well known that many young birds which are still largely dependent upon their parents for food are able to fly considerable distances. Such evidence, however, would be strongly probable of breeding. It should not be necessary to actually find a nest with either eggs or young to establish a breeding record. The continuous presence of an evident pair of birds during the season when they would normally breed, in any given restricted region, ought to be taken as clear evidence of the breeding of that pair. It is frequently not possible to find the nest and examine its contents.

The presence in the north of individuals of a species whose normal range lies well south of such occurrence does not indicate that the species breeds in that northern region. During the migrations and after the breeding season individuals may wander considerable distances from their normal breeding places. While the conclusions here reached are by no means to be considered final, they are at least conservative. It may very likely be that some of the warblers supposed to cross Lake Erie to breed will yet prove summer residents on this side. In editing the notes contributed on the breeding of our birds some records have been withheld because of the lack of positive evidence.

FOOD.

An effort has been made to indicate what constitutes the food of the birds which spend much time in the state. In many instances this has been done under the discussion of the individual species, where the species seems to have a strong influence upon agriculture or other economic interests, and where the food differs in some important respects from that of the other members of the group. When the group is not an important factor, or the food of the species is much the same throughout the group, a discussion will be found under the heading of the whole group. Information upon the food habits of the birds has been gleaned from various sources, acknowledgment of which will be found elsewhere. An effort has been made to acquaint the reader with the facts so far as they are known, and thus to show what species are injurious and what beneficial to our interests.

MIGRATION.

The subject of the migrations of the birds into and across Ohio has not received sufficient careful attention to warrant tabulation of the dates of appearance and disappearance of such species as migrate, nor any plotting of the routes of migrations most generally followed. It is true that several voluntary observers have worked faithfully and well with the time at their disposal, and the results have greatly extended our knowledge of the migrations, but their time and means have been too limited for exact results. They have made possible general statements, however, which will indicate the times of appearance and disappearance and the general routes of movement across the state. These general results are given in this catalogue.

RANGE IN OHIO.

The present Ohio range of the different species has been largely taken from the numerous reports received, supplemented by published records and by the writer's work at

Oberlin and in the several regions of the state visited since the preparation of this catalogue began, two years ago. In accepting records for the state and also for the different counties the following rule has been adopted: In order to have a place on the state list a specimen of the species must have been captured and preserved for some time where it could be critically examined. In order to have a place on a county list a species which is rare or casual or accidental in that county must have had a specimen captured and critically examined, or, if a conspicuously marked species, must have been seen under the most favorable conditions by one familiar with that species. This rule has necessarily resulted in the elimination of some species from some of the lists handed me, and has relegated to the state Hypothetical List some species reported on insufficient evidence as occurring in the state. I submit, however, that it is a fair rule, one which will safeguard our work. It is far easier to add a species to such a list than it is to eliminate it after it is wrongly placed there.

TOPOGRAPHY.

"The state of Ohio is situated between $38^{\circ} 25'$ and 42° north latitude and $80^{\circ} 30'$ and $84^{\circ} 50'$ west longitude. It is thus the most southern of the northern tier of states, its northern border corresponding in latitude with the southern border of Michigan and New York. Its extreme length is, from east to west, about 220 miles, its greatest width from north to south about 210 miles. Its area is approximately 40,000 square miles (41,060: land, 40,760; water, 300.)" (Wheaton.) About three-fourths of the state is under cultivation, and of the remaining fourth nearly all is woodland. "Before cultivation a few small prairies in the western and central portions of the state interrupted the general woodland." The disappearance of the forests has resulted in the almost total extermination of a few birds, a marked decrease in the numbers of a large number, and an influx of a few species which live in the open fields.

DRAINAGE.

"Two-thirds of the state may be considered as forming a part of the great Mississippi Valley, while about the northern third is in the basin of the great lakes. The water-shed which divides the streams flowing into Lake Erie from those tributary to the Ohio, traverses the state from near the north-east corner in a south-westerly direction as a low ridge the greatest elevation of which is nowhere more than 1400 feet above the sea. This water-shed is lower in Ohio than in Pennsylvania and New York." (Wheaton.)

ELEVATIONS.

The surface of Lake Erie is 573 feet above the ocean. During low water the Ohio river is about 426 feet above the ocean at the extreme south-west corner of the state, near Gravel Pit, rising to 687 feet at Wellsville in Columbiana county. The Ohio river at its lowest point is thus 147 feet below the surface of lake Erie. The variations in the general surface of the state range from those given above to 1540 feet, which elevation is reached in Logan county a short distance east of Bellefontaine, where two hills rise, the one to 1500 the other to 1540 feet above tide. A hill in Richland county reaches an elevation of 1475 feet. Nowhere else does the state reach 1400 feet elevation. It will thus be clear that nowhere does altitude play any important part in the distribution of the birds.

EROSION.

The lake Erie drainage plain is generally a gradual slope northward, with gorges cut into the underlying shale and rock by the larger streams, but without hills of any consequence. The northern and western parts of the Ohio river drainage plain is also level, but growing rougher as the streams descend and enlarge, reaching a maximum of roughness in the south-eastern and southern parts of the state. The unglaciated region presents the greatest erosion and consequently the highest ridges and deepest valleys. Here the streams have cut completely through the upper coal strata.

RIVERS.

Only two of the rivers which flow into Lake Erie are of much importance topographically—the Maumee at its western end, and the Grand, near the eastern border of the state. Between these the Portage, Sandusky, Huron, Vermilion, Black, Rocky, and Cuyahoga form greater or lesser valleys, and more or less extensive swamps at their junction with the lake. The principal tributaries of the Ohio are the Muskingum, Scioto, and Miami, and their tributaries, penetrating well into the northern third of the state. They are important highways for the birds in their migrations, and several species belonging to the southern counties follow the courses of these rivers farther north than they venture elsewhere.

LAKES.

Natural lakes of any considerable extent are lacking, but within the drift area in the north-east numerous small glacial lakes are scattered. Four reservoirs built by the state to supply the system of canals, furnish inland waters for many species as feeding and nesting places. St. Mary's or Grand reservoir, situated in Mercer and Auglaize counties, with an area of 17,000 acres, is the largest; the Lewiston, in Logan county; the Loramie, in Shelby; and the Licking, in Licking, Fairfield, and Perry counties, are of smaller dimensions. The marshes which have formed in and around these reservoirs support as abundant swamp life as the delta marshes at the lake shore.

THE BIRDS AND THE WATER BODIES.

On the south the Ohio river exerts a marked influence upon the bird fauna of that part of the state. Being a main tributary of the great Mississippi river, and extending in a somewhat northerly direction from that great thoroughfare of the birds, it receives its portion of the northward moving host each spring. The course of the Ohio river is so little varied in character that it is not strange that some species with somewhat southern tendencies should wander along

its course and unwittingly reach a higher latitude than elsewhere. The river itself has, for the most part, little of the character which entices swamp breeders to its shores. While water birds follow its course they do not tarry to breed there, but pass northward.

On the north Lake Erie is a factor to be reckoned with. It acts as a balance between the extremes of cold in winter and heat in summer, thus maintaining a more even temperature at any time of year, preventing the sudden changes which are so dangerous to both plant and animal life. Its chilling spring influence holds vegetation back until time for it to come forth, and by its warm breath in fall it wards off early frosts. Recognizing this influence upon vegetation, we are prepared for the appearance of some of the more southern breeding birds along the shore of the lake, and for the presence all winter of some of the northern species which ordinarily winter much farther south.

It has already been stated that marshes scattered sparingly along the lake front, usually where streams enter the lake, afford breeding places for many species. The archipelago lying north of Sandusky also affords suitable summer homes for many species not found breeding elsewhere in the state. Wherever clay banks front the water Bank Swallows and Belted Kingfishers nest in numbers.

CLIMATE.

For a detailed discussion of the climatic conditions of Ohio the reader is referred to a paper on "Some Climatic Conditions of Ohio," by Mr. Otto E. Jennings, in the *Ohio Naturalist* for January, 1903. It is sufficient to say here that the mean range of temperature, which is 49° F. in the north and 55° F. in the south, and the much greater depth of snowfall in the extreme north-eastern corner of the state, are the principal factors which exert any marked influence upon bird life. A number of species are not only more common in the warmer southern counties, but several never reach even the middle of the state. Greater snowfall means covered food in winter, and consequently fewer birds during

the period of snow. The rapacious birds, especially, go where food is more easily obtainable during the winter months.

FAUNAL AREAS.

"By far the largest part of the State is strictly Carolinian in its faunal characters; a small portion, the north-eastern corner, is as emphatically Alleghenian." (Wheaton.) Dr. C. Hart Merriam, in "Life Zones and Crop Zones, of the United States," 1898, shows clearly the extent of this arm of the Alleghenian fauna, so far as plant life is affected. I have attempted to indicate this area on the accompanying map. Topographically there seems to be nothing which indicates this difference. It is possible that the influence of the strictly Alleghenian region flows over into Ohio to that extent without any attendant local conditions of topography. A strong hint of the reason for it lies in the much greater snowfall over a large part of this Alleghenian area. The fact that the Hooded Warbler, Worm-eating Warbler, Kentucky Warbler, Golden-winged Warbler, White-eyed Vireo and Summer Tanager invade this area to breed, several of them reaching the lake shore in Ashtabula county, and do not breed as far north anywhere else in the state, would seem to indicate that the conditions which so strongly affect plant life have little or no influence upon these birds. They belong in the Carolinian Fauna.

In northern Ohio there seems a strong tendency toward the Transition Zone, and in the south a strongly typical Carolinian Fauna in the Upper Austral Zone. Thus the Bobolink breeds plentifully all over the northern third of the state, but is scarcely found in summer south of the 40th parallel. Wilson Thrush also breeds north but is absent in summer south. The Black and Common Terns are found only at the lake shore in summer, but the Carolina Wren and Cardinal nest sparingly, but in increasing numbers, even to the lake shore. South of the 40th parallel, except in the extreme north-east, the Kentucky Warbler and Summer Tanager spend the summer.

Careful scrutiny of Dr. Wheaton's work will make apparent to any one that there has been a very perceptible movement of many species northward or north-eastward during the last two decades. Several species known then to breed near the lake shore clearly do not breed there now, or if at all very rarely. Several species which did not reach the lake shore then are regular breeders there now. Some species which were confined to the southern border of the state twenty years ago have now reached the central counties, or pushed even farther north-eastward. Bewick Wren, at least, has invaded the state from the south-west. There is some indication of an invasion of the Blue Grosbeak and Nonpareil soon. In winter, we in the north now have Robins and Bluebirds with us in small numbers, where seven years ago none remained. The temperature is not changing, but the birds are gradually developing into hardier animals.

The species involved in this north-eastward movement may be mentioned. Of the warblers: the Prothonotary, Worm-eating, Golden-winged, Chestnut-sided, Magnolia, Kentucky, and the Hooded. Besides these the Summer Tanager; White-eyed Vireo; Pine Siskin; Lark Sparrow; Dickcissel; Cardinal; Carolina Wren; Bewick Wren; Turkey Vulture; and Wilson Snipe. These are the species most affected. It is more than likely that the whole bird host is gradually shifting northward as the weaker ones perish, leaving only the hardier individuals to occupy the arena of daily strife for existence.

FROM WHENCE BIRDS HAVE COME INTO OHIO.

Birds seem to have appeared upon the earth during the lower Jurassic or possibly even during the upper Triassic times in the world's history. No fossil birds of these times have been found in Ohio, yet it is not impossible that such occurred in the region now named Ohio. However that may be, it is certainly true that the great ice invasion from the north, marking the close of the Tertiary Period and the

beginning of the Quaternary, with its revolutionary changes of climate from almost universal tropic to frigid conditions over the northern half of the northern hemisphere, drove all life out of what is now Ohio. We are therefore concerned only with the reappearance of the birds in the region.

A glance at the accompanying map will indicate the extent of the ice-cap over Ohio. It will be noticed that the south-eastern counties escaped with nothing more than flooding by water in the lowlands when the ice-cap began to recede by melting. It will also be clear that the whole of the state must have been frigid during the most of the year, with perhaps short periods of freedom from snow and ice when the sun was highest in mid-summer. Clearly the conditions were not favorable anywhere in the state then for breeding. Such birds as survived the changes occasioned by the ice invasion, the crowding into the tropics, and the necessary change of diet, must have remained well south of the ice barrier for long periods.

As the ice-cap began to recede in consequence of another change of climate to warmer, the birds, under the necessity of securing more favorable conditions for breeding, must have pushed northward to the limit of the ice, only to be forced south with the approach of winter. With the recurrence of summer and the further recession of the ice these annual migrations would extend farther and farther northward, and the instinct for regular migrations be formed.

This being true, it is clear that the reoccupation of Ohio must have been from a southerly direction. But since the mountains lying eastward and southward now form a considerable barrier to the migrations of the birds, it is likely that they did to an even greater extent then, since time has served to lessen their height. Remembering, also, that birds follow large features of topography in their annual migrations, like river valleys and coast lines, it will seem more than likely that the Ohio tributary of the great Mississippi river served as a highway for the birds living at the close of the Glacial epoch as it does to-day. We are therefore safe in assuming that the first invasion of the region

which is now bounded as Ohio came from the south-west. This is made clearer when we know that the species which have come into the state during the last twenty years to become regular summer residents, have come from the south-west or west. Of the thirteen species regarded as accidental within the state seven must have come from the south-west or west, while five may have come from the east or north-east, at least two of which were pretty clearly driven out of their course by severe storms.

The species which have come into the state since Dr. Wheaton finished his catalogue, or which were not known to him, at least, are as follows: From the south-west and west: Prairie Horned Lark, Henslow Sparrow, Nelson Sparrow, Bachman Sparrow, Little Blue Heron, and Black Rail. The following species have been found as migrants, and can hardly be classed as invaders in the true sense: Parasitic Jaeger, Barrow Golden-eye, American Eider, and Long-billed Dowitcher. Caspian Tern is probably a wanderer from the south.

The following species, known to Dr. Wheaton, have considerably extended their range eastward and north-eastward: Lark Sparrow, Grasshopper Sparrow, Dickcissel, White-eyed Vireo, Prothonotary Warbler, Worm-eating Warbler, Golden-winged Warbler, Kentucky Warbler, Hooded Warbler, Carolina Wren, Bewick Wren, and Carolina Chickadee.

It has already been hinted that there is strong evidence for the belief that several species which earlier ornithologists reported as breeding in the north-eastern counties have ceased to do so, going farther north to spend the summer now. This north-eastward movement can hardly be due to settlement of the country in later years, but rather seems in direct accord with the movement in the same direction of the several species enumerated above. Dr. Merriam shows that a tongue of the Lower Austral life zone reaches about the middle of southern Indiana along the course of the Ohio river. The strong tendency of the birds to follow the course of the Ohio until they reach a latitude considera-

bly north of their normal summer range in Ohio, seems to indicate that this Lower Austral extension may be approaching our southern border, as far as the birds are concerned. This impression is emphasized by the numerous unconfirmed reports of the occurrence of the Nonpareil and Blue Grosbeak in the vicinity of Cincinnati. A further indication of the tendency of the birds, in the latitude of Ohio, to move gradually northward with their breeding range, is shown in the increasing number of species which remain during the entire winter. It indicates that hardier individuals are gradually being developed. Since Ohio lies near the northern border of the breeding range of several species, and just above the northern range of some others, we may expect that the hardiest individuals of such species will gradually invade regions to the north of their range which have not known them hitherto. This law of differentiation is recognized in a practical manner by those who see sub-specific differences between the individuals of certain species which habitually remain well south to breed and those which habitually push well north to breed. This seems to be one of the methods for the development of species.

The appearance of northern breeding birds in the state in winter cannot properly be classed as invasions, because they are forced south by the stress of hunger, and return at the first opportunity. It seems clear that during the migrations of the species which breed north of the state, the movement of species in the western end of the state is a little west of north, and in the eastern part of the state a little east of north. While Lake Erie is not an insurmountable barrier to most species, they seem to prefer not to cross it directly or at all if possible. I have repeatedly seen Killdeer and Meadowlarks strike out boldly for the Canada side, with a favorable wind, only to turn back before they had passed out of sight. It is more than likely that many individuals of the species which migrate by day pass around the ends of the lake, or cross at Sandusky.

SOURCES OF INFORMATION.

In the preparation of this catalogue the author has received much valuable assistance from many sources. He has freely consulted first of all Dr. J. M. Wheaton's great work, and has taken from it many facts. Cook's "Birds of Michigan," Butler's "Birds of Indiana," Warren's "Birds of Pennsylvania," Ridgway's "Birds of North and Middle America," and Nehrling's "Our Native Birds of Song and Beauty," have proved valuable helps in many ways. Without the material support and hearty coöperation of the Ohio State Academy of Science, particularly its committee having in charge the McMillin Fund for research, this catalogue would not have appeared at this time. To Professor Albert A. Wright, for valuable and timely suggestions and for help in the selection of a map; and to Rev. W. L. Dawson, for coöperation and criticism in the compilation of the list of species, I desire to make grateful acknowledgment here. To all those whose names appear below, who gave freely of their time and knowledge of the birds in their localities, is largely due the approximation to completeness of this catalogue. Many have gone out of their way to help the work along. With such an enthusiastic company of friends there is great hope for the future of our native birds.

CONTRIBUTORS.

The following persons have returned lists of the birds of their localities checked upon provisional lists which were furnished for that purpose:

Allen—Homer C. Bennett, M.D., Lima.

Ashland—C. L. Metcalf, McZena.

Ashtabula—W. P. Holt, Rev. J. M. Keck, Geneva, Robt. J. Sim, A. W. Galpin, Jefferson.

Clark—Leander S. Keyser, Springfield.

Columbiana—T. C. Randolph, J. W. Suliot, Salem.

Crawford—Hiram B. Sears, Bucyrus.

Cuyahoga—A. Hall, Lakewood; Prof. Francis H. Herrick, R. J. Tozer, Cleveland.

- Defiance—Charles E. Slocum, M.D., Defiance.
 Delaware—Miss Ida Newell, Prof. Edward L. Rice. Delaware.
 Erie—R. L. Baird, Prof. E. L. Moseley, R. D. L. Ransom, Sandusky; Carl Tuttle, M.D., Berlin Heights.
 Franklin—Rev. W. L. Dawson, Prof. J. S. Hine, Columbus.
 Fulton—Thomas Mikesell, Wauseon.
 Geauga—Rev. J. M. Keck, Orange Cook, Chardon.
 Greene—Eliza G. Rice, Yellow Springs.
 Hamilton—Charles Dury, Russell Everett, Laura Gano, F. W. Langdon, M.D., Joshua Lindhal, Morris Peck, C. C. Smith, Francis P. Smith, Cincinnati; R. F. Souter, Bond Hill.
 Hardin—George H. Palmer, Kenton; Agnew Welsh, Ada.
 Harrison—Harry B. McConnell, Cadiz.
 Knox—T. E. Haughey, Academia.
 Lake—E. A. Doolittle, V. E. and T. B. Wyman, Painesville; Rev. J. M. Keck, Mentor.
 Licking—Irving A. Field, Granville; Raymond Osburn, Vannatta.
 Logan—Homer C. Bennett, M.D., Bellefontaine.
 Lorain—Lynds Jones, Oberlin.
 Lucas—F. H. Burglehouse, Miss Lucy J. Retscher, Toledo.
 Madison—Max Morse, London.
 Mahoning—E. W. Vickers, Ellsworth.
 Morgan—E. J. Arrick, C. H. Morris, McConnellsville.
 Perry—Rev. Henry Beeman, New Lexington; Geo. W. DeLong, Corning.
 Pike—Rev. W. F. Henninger, Waverly.
 Portage—Cornelius Baldwin, Nelson; Geo. H. Colton, Hiram; Roscoe J. Webb, Garrettsville.
 Preble—Julia K. Holn, Lewisburg.
 Scioto—Rev. W. F. Henninger, South Webster.
 Summit—Eugene F. Cranz, Ira; Wm. B. Haynes, Akron.
 Union—Lizzie A. Copp, Richwood.
 Warren—Anna C. Stenson, Harveysburg.
 Wayne—J. G. Black, Scott G. Harry, Harry C. Oberholser, Ethel Dane Roberts, Wooster.
 Wyandot—Thos. A. Bonser, Carey; Paul Smith, Upper Sandusky.

In addition to the names mentioned above, valuable notes have been received from Dr. W. H. Fisher, of Cincinnati, from his records of specimens in his private collection, relating to food and the occurrence of many species, and from Mr. E. B. Williamson, giving dates of nesting of many species in various places in the state. Clippings from lo-

cal newspapers in which birds are mentioned, which have been sent to me by many helpers, are too numerous and the sources from which they came too various to be given individual mention here.

Dr. Frank W. Langdon, Mr. Charles Dury and Dr. Josua Lindahl have contributed notes covering a long series of years in the vicinity of Cincinnati and elsewhere in the state; and Mr. Wm. B. Haynes, of Akron, has given special attention to the shore birds of the natural lakes of that vicinity.

Mr. H. C. Oberholser has been good enough to go over the list of species here recorded, making suggestions and comments which have greatly aided me in the final arrangement of the catalogue. His "Birds of Wayne County, Ohio," and Rev. W. F. Henninger's "Birds of Middle Southern Ohio," have been valuable aids in the revision of the work.

In 1891 Messrs. L. M. McCormick and G. D. Wilder prepared a list of the birds of Lorain county, from which I have been able to add not a little to our knowledge of the birds of the northern parts of our state.

To these gentlemen and to all who have given so freely of their time and notes I wish to tender my grateful thanks. They have made a difficult task possible of accomplishment.

In addition to the counties represented upon the list given above, the writer has been able to spend a greater or less time in studying the birds in the following counties: Athens, Fairfield, Gallia, Huron, Lawrence, Medina, Meigs, Muskingum, Ottawa (islands only), Perry, and Washington. The work in all of these counties, except Huron and Medina, was done in company with Rev. W. L. Dawson. At Chippewa Lake, Medina county, Mr. R. L. Baird accompanied me. Mr. Baird has also been associated with me in considerable of the later work about Oberlin. At the Licking Reservoir, which included parts of Licking, Fairfield, and Perry counties, Messrs. E. J. Arrick and Irving A. Field also participated. Several days were spent in the vicinity of Jefferson, Ashtabula county, with Mr. Robt. J.

Sim. Most of the work in Erie and Huron counties has been without company.

From the foregoing remarks it will be clear that a considerable portion of the state remains to be explored ornithologically, particularly in the south and west. Some persons with considerable leisure ought to be posted along our southern and western borders to watch for invasions of species from Kentucky and Indiana. I earnestly hope that the appearance of this catalogue will mark the beginning of an era of unusual activity in the study of the birds of our fair state.

THE BIRDS OF OHIO.

ORDER PYGOPODES. Diving Birds.

SUBORDER PODICIPEDES. Grebes.

Family PODICIPIDÆ. Grebes.

This family is represented in our state by three species, one large and two small. The food consists of fish, aquatic insects, crustaceans, batrachians, and considerable aquatic vegetable matter. The grebes pursue the fish under water, using only the feet in swimming under water. A Horned Grebe found on the streets of Oberlin, February 9, 1895, by Mr. H. C. Tracy, had completely filled its gizzard with small rubber bands, probably picked up on the street under the supposition that they were worms. The bird was found in an exhausted condition, and soon died.

(The first number at the left is the serial number of this catalogue. The second number, which is in parenthesis, is the present number of the species in the Check-List of the American Ornithologists' Union. The number to the right of the scientific name and authority is the number found in Dr. Wheaton's Check-List, pages 571-584, of his catalogue.)

1. (2.) COLYMBUS HOLBÆLLII (Reinh.). 287.
Holbæll Grebe.

Synonyms: *Podiceps grisigena* var. *holbælli*, *P. holbælli*, *P. grisigena*.

American Red-necked Grebe, Red-necked Grebe.

Kirtland, Ohio Geol. Surv., 1838, 166, 187. (*Podiceps rubricollis*.)

This is a rare and irregular winter visitor and migrant, upon almost any of the Ohio lakes, reservoirs or rivers. There have been fewer records since Dr. Wheaton's catalogue was printed than before.

2. (3.) *COLYMBUS AURITUS* Linn. 288.
Horned Grebe.

Synonyms: *Dytes auritus*, *Podiceps cornutus*.

Audubon, Orn. Biog., III, 1835, 429.

While this grebe is not common during the migrations it can hardly be called rare in most parts of the state. It is somewhat regular as a migrant, but may be found during the winter. Companies of a dozen or more individuals in full spring dress are not infrequent on Lake Erie. During the southward migration there is a strong tendency for the birds to occur two at a time on the smaller waters. The report of the breeding of this species in Ottawa county has not been confirmed.

This grebe is as good a diver as the more familiar Pied-billed, for which it is often mistaken. The slenderness of the bill should always easily distinguish it from that species.

In the migrations the Horned Grebe reaches Oberlin about the middle of April and remains until about the first of May. It returns early in October and tarries until ice forms on the ponds, and may be found at any time during the winter about open water.

3. (6.) *PODILYMBUS PODICEPS* (Linn.). 289.
Pied-billed Grebe.

Synonyms: *Podiceps carolinensis*, *Colymbus podiceps*.

Pied-billed Dabchick, Thick-billed Grebe, Dabchick, Dipper, Didipper, Diedapper, Water-witch, Hell-diver, Devil-diver.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

This is the most familiar grebe in Ohio, known by a diversity of names to suit the experiences of each individual hunter. However, the modern shot-gun or rifle is too quick for him. To be sure he sometimes succeeds in dodging the lead thrown at him, but far oftener he falls a victim to it, as the breasts which may be seen on hats and in boas too well show.

This grebe nests sparingly all over the state where conditions may be favorable. One could hardly call the species

common anywhere, but individuals are to be found during the spring and fall months, on almost any body of water a half acre in extent.

Lorain county dates for spring appearance fall within the last week of March, and the departures during the second week in October.

SUBORDER CEPPHI. Loons, Auks, Murres etc.

Family GAVIIDÆ. Loons.

Three species belonging to this family inhabit Ohio more or less regularly. Only one species, the Loon, is regular in its appearance, the other two reach the state only in severe winters. The food is similar to that of the Grebes, with a larger proportion of fish, probably, and somewhat less of vegetable matter.

4. (7.) *GAVIA IMBER* (Gunn.). 290.
Loon.

Synonyms: *Colymbus torquatus*, *C. imber*, *C. glacialis*, *Urinator imber*.

Great Northern Diver, Common Loon.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

The Loon is no longer a common bird anywhere in the state, but it is not infrequently seen during the migrations on the larger waters. It is apparently a rare summer resident in the region of Sandusky and Toledo, and possibly elsewhere along the lake shore.

At Oberlin it has been seen in late April and early October, but no definite dates of migration can be given. Rev. Mr. Henninger has found it as late as the first of May at Piketon.

5. (9.) *GAVIA ARCTICA* (Linn.). 291.
BLACK-THROATED LOON.

Synonyms: *Colymbus arcticus*, *Urinator arcticus*.
Black-throated Diver.

Wheaton, Ohio Geol. Surv., 1882, 565.

This loon is casual as a winter visitor in the state. There have been a number of specimens captured since that recorded by Dr. Wheaton, which was captured near Kelley's Island instead of in Sandusky Bay, Mr. Roscoe J. Webb, who secured the specimen from Mr. Crane in whose collection it was, tells me.

6. (11.) *GAVIA LUMME* (Gunn.). 292.

Red-throated Loon.

Synonyms: *Colymbus septentrionalis*, *Urinator lumme*, *Colymbus lumme*.

Red-throated Diver.

Wheaton, Ohio Agri. Rep. for 1860, 371, 379.

This loon is everywhere rare in the state. It has been taken at Cincinnati, according to Mr. Dury and Dr. Langdon, and at Wheelersburg, Scioto county, by Rev. Mr. Henninger. It is rare on Lake Erie. No dates of migration can be given, but it is probably to be found in late March.

ORDER LONGIPENNES. Long-winged Swimmers.

Family STERCORARIIDÆ. Skuas and Jaegers.

Two species of this small family reach our state more or less regularly, but are rare everywhere. They are the birds of prey among the gulls and terns, getting a large part of their living by forcing the gulls and terns to drop their catch of fish, thus stealing it from them. It is not clear whether these birds ever eat the garbage thrown out from cities into the ocean; if hard pressed for food they might do so.

7. (36.) *STERCORARIUS POMARINUS* (Temm.). 286.

Pomarine Jaeger.

Synonyms: *Stercorarius pomatorhinus*, *Larus pomarinus*.

Wheaton, Ohio Geol. Surv., 1882, 545.

The records of this rare species are as follows: H. E. Chubb, Cleveland, fall of 1880 (Wheaton, 1882); E. L.

Moseley, Sandusky, Oct., 1889 (Cook, Birds of Michigan, 26); A. Hengartner, Lorain, date not known. It is likely to be found on any of the larger waters with flocks or companies of gulls.

8. (37.) STERCORARIUS PARASITICUS (Linn.). —
Parasitic Jaeger.

Synonyms: *Larus parasiticus*.

Smith, Raymond W., Journal Cin. Soc. Nat. Hist., XIV, 1891, 107.

The specimen here recorded was captured near Lebanon, at the close of a week of very stormy weather, in the latter part of March or the early part of April, 1880. Name of captor not given. It was given to Mr. J. E. Gould, who preserved it in his collection. This appears to be the first published record.

E. L. Moseley reports three specimens preserved in local collections in Sandusky as follows: Oct. 6, 1895; Sept. 13, 1899; also 'a Jaeger probably of this species Sept. 20, 1889,' Frey. There is a specimen of this species in the collection of Mr. A. Hengartner, Lorain, which Mr. Hengartner shot near Lorain on the lake shore.

Another specimen is recorded by Prof. F. M. Comstock, in *The Auk*, XIII, 1896, 171, captured near Sandusky, in November, 1895. Prof. Comstock also mentions a record in the Cleveland Academy of Science Proceedings, by Dr. Kirtland, of a specimen probably of this species captured at the mouth of Rocky River, in November, 1857. Volume and date of the publication not given.

Family LARIDÆ. Gulls and Terns.

Sub-family LARINÆ. Gulls.

The gulls differ from the terns in generally larger size and in their manner of feeding, as well as somewhat in the food eaten. There are two gulls regularly found in the

state at some time of the year, and five which appear occasionally.

While flying over the water in search of food they hold the head horizontally, so that the bill is in a line with the body. They do not plunge into the water for a fish or other food, but settle upon it, or take fish or other food from the surface. They catch fish alive, eat dead fish which may be thrown upon the shore by the waves, and eat greedily of the garbage thrown out from coast cities. The smaller gulls may also eat some insects. Gulls often follow in the wake of ships and snatch any morsel of food which may be thrown into the water.

As scavengers the gulls take first rank because they are the most numerous birds along our coasts. They congregate about the garbage scows in great numbers and prevent garbage from washing ashore to pollute earth and air. The laws for their protection should leave no room for a doubt as to their meaning in the mind of any one.

9. (43.) *LARUS LEUCOPTERUS* Faber. 274.
Iceland Gull.

Synonyms: White-winged Gull.

Wheaton, Ohio Agri. Report, 1860, 370, 379.

Besides the record which Dr. Wheaton has left us, of the capture of two or three specimens in Cleveland harbor, on the authority of Mr. R. K. Winslow, the only record is for Lorain, Dec. 22, 1888, on the authority of Mr. L. M. McCormick. A specimen was captured near Lorain on the lake, and preserved in the Oberlin College museum.

10. (47.) *LARUS MARINUS* Linn. 275.
Great Black-backed Gull.

Synonyms: Saddle-back, Coffin-carrier, Cobb.

Audubon, Orn. Biog., III, 1835, 98.

Dr. Wheaton's records for this gull are admittedly weak, and I am therefore glad to strengthen them by one actual capture and one other record which is hardly open to ques-

tion. Mr. E. W. Vickers reports "One found dead floating among ice in the creek near Canton." Rev. W. F. Henninger adds another record for Pike county, March 21, 1901. (Wilson Bulletin No. 40, 1902, page 79.) Individuals should be found occasionally on Lake Erie during the winter, and wanderers might occasionally reach Kentucky.

11. (51.) *LARUS ARGENTATUS* Brünn. 276.
Herring Gull.

Synonyms: *Larus argentatus smithsonianus*.

American Herring Gull.

Audubon, Orn. Biog., III, 1835, 98.

It is, perhaps, not quite true that this gull is a resident in the state in spite of the fact that birds have been seen on the lake shore during every week in the year, because there are no breeding records. Probably the summer birds were wandering males or unmated birds. It is a common bird locally on the larger streams and lakes during the migrations, but does not seem to be a winter resident upon any of the inland waters, except possibly the Ohio river.

The Lake Erie flocks are much larger after the middle of March than during the winter. Only during the period when the lake is well filled with ice are the numbers few. During the severest weather they remain near the fish houses or follow the ice cutters, unless there be rifts of open water not far out.

12. (54.) *LARUS DELAWARENSIS* Ord. 277.
Ring-billed Gull.

Synonyms: Common American Gull.

Audubon, Orn. Biog., III, 1835, 98.

I have looked for this gull in vain. It is reported as rare everywhere in the state. What Dr. Wheaton says of it would indicate that even as he wrote in 1882, the numbers were growing considerably less. There appears to be no evidence of its breeding within the state. It is possible that several of the gulls formerly nested on the islands within

the international boundary, before they were so fully settled, but positive evidence of the breeding of this species is lacking.

13. (60.) *LARUS PHILADELPHIA* (Ord.). 278.

Bonaparte Gull.

Synonyms: *Larus capistriatus*, *L. bonapartii*, *Choicocephalus philadelphia*, *Sterna philadelphia*.

Bonaparte's Rosy Gull.

Audubon, Orn. Biog., IV, 1838, 212.

This is the most common small gull, but it is only locally common during the migrations. It is said to breed on Gull Island in Lake Erie, but I have been unable to verify this statement. It was not found on the small islands north of our boundary. Migration dates are unsatisfactory and irregular. The species probably reaches the state in late April.

14. (62.) *XEMA SABINII* (Sab.). 279.

Sabine Gull.

Synonyms: *Larus sabinii*, *Xema sabinei*.

Fork-tailed Gull.

Wheaton, Ohio Agri. Report, 1860, 371, 379.

This record is apparently based upon a single specimen in immature plumage captured in Cleveland harbor by Mr. R. K. Winslow, earlier than 1880, and preserved for a time in the collection of the Ohio Medical College. It had been destroyed previous to 1882.

Subfamily STERNINÆ. Terns.

Seven species of terns occur in Ohio, the Common and Black being the only regular visitors in summer. Terns fly with the bill pointing down instead of forward, and the species which we find have a forked tail, while the gulls have a square cut tail. The terns dive into the water for fish. They also eat garbage, and the smaller ones, at least, feed upon insects after the fashion of the swallows. As scavengers they are useful birds, but doubly increase our debt to

them by feeding upon insects as well. The law against killing or injuring gulls and terns should be carefully observed and rigidly enforced. It is unlawful to possess any part of a gull or tern, as well as any part of most other wild birds, in Ohio.

15. (63.) *GELOCHELIDON NILOTICA* (Hasselq.). 280.
Gull-billed Tern.

Synonyms: *Sterna anglica*, *S. aranea*, *S. nilotica*.
Marsh Tern.

Kirtland, Ohio Geol. Surv., 1838, 166, 185.

Its place on our list is based upon the above reference, and upon specimens reported by Mr. R. K. Winslow for the vicinity of Cleveland. It seems likely that more familiarity with this species will prove that it is more regular as a summer visitor than has been supposed.

It has not been found in Indiana nor in the western part of Pennsylvania, but it is reported as breeding on the St. Clair flats.

16. (64.) *STERNA CASPIA* (Pall.). —.
Caspian Tern.

Synonyms: *Sterna tschegrava*.
Imperial Tern.

Dury, Catalogue of Birds, Animals and Fishes, 1886, 4.

Mr. Charles Dury reports specimens from Ross lake, Little Miami river, Ohio river near the Miami river; specimens from which places are in his collection and in that of the Cincinnati Society of Natural History. Prof. Moseley reports it from Sandusky. I have a record for Licking reservoir, May 31, 1902. It must be regarded as a summer straggler in the state.

17. (69.) *STERNA FORSTERI* Nutt. 281.
Forster Tern.

Wheaton, Ohio Agri. Report, 1874, 515.

Forster Tern is apparently casual in the state. I have received no records since those given by Dr. Wheaton. The

difficulty of identifying this tern renders it probable that many occurrences are not noted.

"Mr. Langdon gives it as a rare migrant in the vicinity of Cincinnati, where Messrs. Dury and Freeman note six specimens taken May 4, 1879. My own experience with the bird in this vicinity is limited to a single specimen taken in the fall of 1861 or 1862." (Wheaton.)

18. (70.) STERNA HIRUNDO Linn. 282.
Common Tern.

Synonyms: *Sterna fluviatilis*, *S. wilsonii*.

Wilson's Tern, Sea Swallow.

Nuttall, Man., II, 1834, 271.

As its name implies, this tern is the common form during the migrations wherever there is a lake or large stream. It is not everywhere common, however, but may be locally so anywhere in the state. It breeds in large numbers on the islands just north of our boundary, and less numerous on a few of the smaller islands within our boundary. It has been reported as breeding at Sandusky, but no nests appear to have been found there. The birds seen during the summer in the bay and that vicinity are clearly not breeding birds but wanderers in search of food.

During the second week in May it is abundant along the lake front, then usually appearing in loose companies of from ten to fifty or more individuals.

The migrations occur during the first week in May, or the last week in April, and from the first week in August well into October or even November in the southern counties.

19. (72.) STERNA DOUGALLI Montag. 283.
Roseate Tern.

Synonyms: *Sterna paradisea*.

Paradise Tern.

Audubon, Orn. Biog. III, 1835, 98.

According to the records this species has been found in Ohio less than a half dozen times, once at Cincinnati by Dr. Frank W. Langdon, and the others at the lake shore.

20. (74.) STERNA ANTILLARUM (Less.). 284.

Least Tern.

Synonyms: *Sterna minuta*, *S. frenata*, *S. superciliaris*, *Sternula antillarum*, *Sterna superciliaris antillarum*.

Audubon, Orn. Biog., IV, 1838, 175.

The records for this tern are few but well scattered over the state. It appears to be a rare migrant everywhere. I have never seen it at the lake shore. Its routes of migration may be largely confined to the western half of the state.

21. (77.) HYDROCHELIDON NIGRA SURINAMENSIS (Gmel.). 285.

Black Tern.

Synonyms: *Hydrochelidon lariformis surinamensis*, *H. lariformis*, *H. plumbea*, *H. fissipes*, *Sterna nigra*, *S. surinamensis*.

Short-tailed Tern.

Audubon, Orn. Biog., III, 1835, 535.

The Black Tern is nowhere as common as the Common Tern, but it is not at all rare as a summer resident in the vicinity of Sandusky and Toledo. I have been unable to find it farther east as a summer resident. While the Common Terns breed upon the islands well up from the water the Black Terns choose the marshes, building a nest on the rotten floating vegetation in the swamps where there is no danger from waves.

The spring migrations occur during the second week in May at Oberlin, but probably a week earlier in the region of Sandusky. I have no records for the departure southward. We found them on the Ohio river late in August.

ORDER STEGANOPODES. Totipalmate Swimmers.

Family PHALACROCORACIDÆ. Cormorants.

One member of this family passes across Ohio, and nested in former years. Cormorants are great fish eaters, and probably eat little if anything else. The Chinese train them to fish for them.

22. (120.) PHALACROCORAX DILOPHUS (Swain). 272.
Double-crested Cormorant.

Synonyms: Graculus dilophus, Pelecanus (Carbo) dilophus.
Wheaton, Ohio Agri. Report, 1874, 575.

The cormorants are not well enough known to give us much of an idea of their distribution in the state. This one appears to be a rare migrant in the western half, probably, passing across the state without stopping usually, since there is no suitable feeding place except the reservoirs. Dr. Wheaton states that this species may have nested at the Licking reservoir in earlier years. Mr. Dury found it nesting at St. Mary's reservoir more than twenty years ago.

Family PELECANIDÆ. Pelicans.

Of the three species in this family only the American White Pelican is found in Ohio. This pelican lives upon fish which it scoops up from the water in the capacious pouch hanging to its lower mandible. There is no evidence that it carries either fish or water in the pouch while flying, since its young are fed upon partially digested fish disgorged from its crop.

23. (125.) PELECANUS ERYTHORHYNCHOS Cmel. 271.
American White Pelican.

Synonyms: Pelecanus trachyrhynchus, P. onocrotalus.
White Pelican.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

The pelican is a rare migrant across the state. So conspicuous a bird would be reported generally if it occurred. One was shot at the Licking reservoir about May 15, 1902. It has been seen at Oberlin twice. The records are few and scattering, but seem to indicate that it is confined to the western half of the state.

ORDER ANSERES. Lamellirostral Swimmers.

Family ANATIDÆ. Ducks, Geese, and Swans.

The members of this order must be treated under the subfamily groups.

Subfamily MERGINÆ. Mergansers.

All three American members of this subfamily occur in Ohio somewhat regularly during the migrations. They are properly designated "Fish Ducks," because they feed largely upon fish, but probably also eat mollusks, crustaceans, frogs, and other aquatic animals to some extent. Dr. Warren states that in diving they use the wings as well as the feet for propulsion. On the surface of the water they certainly use their wings when hard pressed to get away, but are unable to fly up. The flesh of the two larger species is rank and fishy, but the Hooded Merganser is a table delicacy.

24. (129.) Merganser americanus (Cass.). 268.
American Merganser.

Synonyms: *Mergus merganser*, *M. m. americanus*, *M. americanus*.

Merganser, Goosander, Fish Duck, American Sheldrake.
Kirtland, Ohio Geol. Surv., 1838, 166, 187.

Both mergansers remain all winter where there may be open water sufficient for feeding. This form appears to be the more common of the two belonging to the genus *Mergus*. It is found on Lake Erie well into January, but is not found during the period when the lake is ice bound—during the most of February and sometimes the first week of March. It has passed north by the third week in April.

25. (130.) Merganser serrator (Linn.). 269.
Red-breasted Merganser.

Synonyms: *Mergus serrator*.
Red-breasted Sheldrake.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

This "Fish Duck" is not only less common than the preceding species, but is even rare over most of the state. It is seldom seen during the winter months, but must still be considered a winter visitor as well as a rare migrant across the state. Its occurrences are too few and too scattered to assign migration dates.

26. (131.) *LOPHODYTES CUCULLATUS* (Linn.). 270.
Hooded Merganser.

Synonyms: *Mergus cucullatus*.

Saw-bill, Topknot, Hooded Sheldrake.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

While this merganser is rather more numerous than either of the larger species, it is only locally common in the state as a migrant. There are no records of its breeding within our borders. While the others are more frequently seen on the lakes and larger streams, this is a river duck as far as its habits and routes of migration are concerned. I have never seen it except on the smaller streams and ponds. It visits the Oberlin water-works reservoir during the spring, with the hosts of other ducks, but always keeps to itself while resting and feeding. The conspicuous "hood" with the large white patch in its center, furnishes a mark for certain identification of the breeding males.

The Hooded Merganser passes Oberlin about the middle of April. It is seldom seen during more than a week all together.

Subfamily ANATINÆ. River Ducks.

This subfamily is represented by an even dozen species and subspecies in Ohio, two of which are accidental in the state. The River Ducks are dabblers in shallow water, turning tail up and immersing only the head, neck, and fore part of the body when feeding. It does not, therefore, follow that they never dive, for they often do. The food of this group is largely vegetable, both aquatic and non-aquatic; weed seeds comprise a good part. The flesh

of all is considered a great delicacy. The birds do not feed entirely in the water, but may often be found on the land, especially during the summer months.

27. (132.) *ANAS BOSCHAS* Linn. 247.

Mallard.

Synonyms: *Anas domestica*.

Kirtland, Preliminary Report, Ohio Geol. Surv., 1838, 67.

The Mallard is locally common during the migrations, but it is almost absent from many localities. It breeds irregularly from the southern border of the state at least to Columbus, and seems rather more common as a summer resident in the northern half, but is very local in its summer distribution anywhere in the state. It is seldom that anything but small flocks are seen in the migrations. At the lakes and marshes they may be found in greater numbers together. It is probably true that males of this species may be found during the summer much farther south and in many localities in the state where there are no breeding females. The males are wanderers and apparently have no care for the brood.

The migrations of the Mallard begin during the first week in March, at Oberlin, and continue well toward the close of the month. Individuals that were clearly migrating have been seen as late as the middle of April. The southward migrations are at their height about the middle of November, but vary with the weather.

28. (133.) *ANAS OBSCURA* Gmel. 248.

Black Duck.

Synonym: Dusky Duck.

Kirtland, Preliminary Report, Ohio Geol. Surv., 1838, 67.

The recent division of this species into two forms makes it doubtful what the status of the two forms for Ohio is. An examination of skins in two collections indicates that this form is the less common in Ohio.

Dr. Wheaton regarded the Black Duck as a casual sum-

mer resident in the northern parts of the state, but I find no corroborative evidence to that effect. It is more often seen in pairs or singly than the Mallard, and appears to be less wary, frequenting small ponds and streams which the Mallard avoids.

The migrations occur at the same time as the Mallard, with possibly a little earlier return in the autumn.

29. (133a.) *ANAS OBSCURA RUBRIPES* Brewst.
Red-legged Black Duck.

Henninger, Wilson Bulletin, No. 41, 1902, page 134.

The recent addition of this subspecies to our fauna makes any statement about its range in the state of little value. It seems likely to be found not uncommon during the migrations, probably in company with the Black Duck. Collections seem to indicate that this is the more common form for Ohio, if it does not prove to be the regular migrant to the almost exclusion of the other form. Ohio collections contain both forms.

30. (135.) *CHAULELASMUS STREPERUS* (Linn.). 249.
Gadwall.

Synonyms: *Anas strepera*.
Gray Duck.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

The Gadwall appears to be rare as a migrant. Reports are not only few but generally unsatisfactory. It is certainly among the disappearing ducks in Lorain county. Prior to 1885 it was one of the market ducks on the lake shore, but it is not seen there now. I have no migration records that will give any idea of the movements of this species.

31. (137.) *MARECA AMERICANA* (Gmel.). 251.
Baldpate.

Synonyms: *Anas americana*.
American Widgeon.

Kirtland, Preliminary Report, Ohio Geol. Surv., 1832, 67.

This once abundant duck is now common only locally and there only occasionally. It has become wary and hard to approach. In Lorain county I have seen only single individuals and two together, and they on the smaller unfrequented ponds. Lately several have formed the habit of visiting our water-works reservoir, in spite of the fact that it lies well within the town. If it breeds within the state now there is no mention of that fact in the reports received. Dr. Langdon mentions its breeding in Ottawa county.

Migration dates for the spring movements fall within the third week of March for southern Ohio, but almost a month later for Oberlin. The southward movement occurs late in October.

32. (139). *NETTION CAROLINENSIS* (Gmel.). 254.
Green-winged Teal.

Synonyms: *Anas carolinensis*, *Querquedula carolinensis*.
American Green-winged Teal.

Audubon, Orn. Biog., III, 1835, 219.

This teal is reported as a common migrant across the state. It is the earlier of the two teals, arriving with the Mallards and other early ducks. I have seen several individuals of this species migrating in flocks of Mallards. It has not yet been found in Lorain county during my studies anywhere but on the lake. None have visited our water-works reservoir.

33. (140.) *QUERQUEDULA DISCORS* (Linn.). 253.
Blue-winged Teal.

Synonyms: *Anas discors*.

Kirtland, Preliminary Report Ohio Geol. Surv., 1838, 67.

This is a common duck locally during the migrations, but it is clearly less common than during Dr. Wheaton's time. It may be found on the smaller streams and ponds as well as on the larger rivers and lakes. In Lorain county I have found it only on the small ponds in twos and threes or singly. Flocks are sometimes seen passing northward.

The spring migrations are late for a duck, occurring during late April, and the fall migrations in October.

Dr. Langdon found it breeding in Ottawa county years ago, but there are no recent records of its nesting there.

34. (142.) SPATULA CLYPEATA (Linn.) 252.
Shoveller.

Synonyms: *Anas clypeata*.
Spoon-bill, Broad-bill.

Kirtland, Ohio Geol. Surv., 1838, 166.

From a "very common migrant" this duck has become almost rare everywhere in the state. It has been recorded less than a dozen times, in the last fifteen years, in Lorain county, and then either singly or in small companies. If it once nested in the state it has ceased to do so. Dr. Wheaton inclined to the belief that it would be found nesting in the northwestern counties. I have been unable to verify this.

It may be found during March and as late as December. Migration dates are too scattering to give its movements accurately.

35. (143.) DAFILA ACUTA (Linn.) 250.
Pintail.

Synonyms: *Anas acuta*.
Spring-tail, Sprig-tail.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

The Pintail appears to be about the most numerous of the ducks sought after by the hunters. It is seen in considerable flocks during both the spring and autumn migrations, and not infrequently stops on the smaller ponds and streams. It is always wary and hard to approach. It sometimes remains all winter in favorable localities, but has not been known to breed.

The migrations of this duck begin late in February or early in March, and may continue until the first week in April at the lake shore. It comes south with the first touch

of winter, and is gone from the northern parts of the state with the freezing of the streams and ponds.

36. (144.) *AIX SPONSA* (Linn.). 255.
Wood Duck.

Synonyms: *Anas sponsa*.

Summer Duck, Tree Duck, The Bride.

Audubon, Orn. Biog., III, 1835, 52.

This duck breeds throughout the state in favorable localities. It nests in the woods some distance from water, but must have feeding places within reach of the nest. The young are said to be carried to the water when hatched. There seems to be little difference in numbers during the migrations from those during summer. It can hardly be called a common species, yet it is hardly rare. The first birds appear at Oberlin about the middle of April and are gone by the last of October.

Subfamily FULIGULINÆ. Sea and Bay Ducks.

Fourteen species represent this family in our state, some of them being rare. The members of this group dive when feeding, frequently to considerable depths. Their food consists of the seeds and roots of aquatic plants, mollusks, crustaceans, and some fish in winter. Some members of the group dive as readily as the true divers. Most of the species are found in flocks of varying size during the migrations.

37. (146.) *AYTHYA AMERICANA* (Eyt.). 260.
Redhead.

Synonyms: *Aethya americana*, *Fuligula ferina* var. *americana*, *F. ferina*, *F. americana*.

Pochard, American Pochard.

Kirtland, Preliminary Report Ohio Geol. Surv., 1838, 67.

The Redhead is only tolerably common as a migrant. It visits the ponds and small streams as well as the larger bodies of water. It is a fairly regular visitor to the Oberlin water-works reservoir both spring and autumn.

Its migrations cover the period from the second week in March to the second week in April, and at the same period in October and November, except that it may tarry even into December in favorable years.

38. (147.) *AYTHYA VALLISNERIA* (Wils.). 259.
Canvas-back.

Synonyms: *Aethya vallisneria*, *Fuligula vallisneria*, *Anas vallisneria*.

Canvas-back Duck.

Kirtland, Ohio, Geol. Surv., 1838, 166, 187.

The delight of the epicure, and therefore hunted down by every market hunter, this duck has become scarce. I have seen it twice in Lorain county in the last ten years, once when it visited the Oberlin water-works reservoir.

It appears to migrate at the same time as the Redhead, but migration dates are too few to make any positive statements possible.

39. (148.) *AYTHYA MARILA* Linn. 256.
Greater Scaup Duck.

Synonyms: *Fulix marila*, *Fuligula marila*, *Aythya marila ne-arctica*.

Greater Black-head, Big Black-head, Blue-bill, Broad-bill, Raft-duck, Flocking Fowl, Shuffler, American Scaup Duck.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

In my experience this Scaup Duck is about one-fourth as numerous as the Lesser Scaup; that would make it hardly common. There is often one or two of this species in the flocks of Lesser Scaups which visit the Oberlin water-works reservoir every year. There is no evidence that this species breeds within the state. The birds which may be found on the reservoirs during the summer, while they may be of both sexes, are not breeding, but are no doubt wounded birds unable to migrate. Their bodily condition would make breeding out of the question.

The migrations are rather late, occurring late in March or early in April, and continuing for two or three weeks. In

the autumn they begin in late October and continue well toward the close of November, or later if the conditions be favorable.

40. (149.) *AYTHYA AFFINIS* (Eyt.). 25. 7
Lesser Scaup Duck.

Synonyms: *Fulix affinis*, *Fuligula affinis*.

Lesser Black-head, Little Black-head, Little Blue-bill.

Audubon, B. Am., VI, 1843, 316.

This is probably the most familiar duck to residents of Ohio. It is apparently less numerous than the Pintail, but is far less wary and so more frequently seen by the casual bird student or hunter. It seems to prefer the smaller waters, and is a regular and numerous visitor to the Oberlin water-works reservoir. It is a rare summer resident in Lorain county, and has been reported as breeding in Summit county. It probably breeds sparingly in the northern third of the state. Considerable numbers of both sexes of this species were found during the summer on both the Licking and Lewiston reservoirs, but they proved to be crippled birds and were not breeding.

The migrations begin late in March or early in April, and flocks of considerable numbers are seen at Oberlin as late as May 5th. Their return is dependent in large measure upon the weather. The first are usually seen during the second week in October, and some may tarry well into November.

41. (150.) *AYTHYA COLLARIS* (Donov.). 258.
Ring-necked Duck.

Synonyms: *Fulix collaris*, *Anas collaris*, *Fuligula collaris*,
Fuligula ruftorques.

Ring-bill, Ring-billed Black-head, Ring-necked Scaup Duck,
Marsh Blue-bill.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

This duck is little known, and is reported as rare throughout the state. Dr. Wheaton reported it as abundant. I have found it but once in Lorain county, and that once on

the Oberlin water-works reservoir. It appears to migrate with the other members of its genus, but there is no evidence that it breeds within the state.

42. (151.) *CLANGULA CLANGULA AMERICANA* (Bonap.).
261.

American Golden-eye.

Synonyms: *Clangula glaucium americana*, *Bucephala clangula*, *B. americana*, *Clangula americana*, *C. glaucium*, *Glaucionetta clangula americana*, *Fuligula clangula*.

Golden-eyed Duck, Whistler, Garrot, Great-head, Whistle-wing.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

The Golden-eye is hardly common regularly, and frequently rare. It sometimes appears in considerable numbers on the rivers and lakes, and may sometimes be found on the larger ponds. It may remain during the winter in favorable localities under favorable conditions. It has not been seen on Lake Erie during the entire winter, but sometimes remains into January. It does not breed in the state.

The Golden-eye is one of the earlier migrants in spring and later in autumn, migrating with the Mallard and Pintail.

43. (152.) *CLANGULA ISLANDICA* (Gmel.). —
Barrow Golden-eye.

Synonyms: *Glaucionetta islandica*, *Anas islandica*.

Rocky Mountain Garrot or Golden-eye.

McCormick, Auk, 1892, 397.

If one could judge from the records, this is an almost unknown bird in Ohio. It is reported from Sandusky Bay, by Prof. E. L. Moseley, and has been taken twice in Lorain county, once by Mr. L. M. McCormick (see above reference) and once by the writer, on the Oberlin water-works reservoir. It should be found during the winter on the waters of the northern part of the state.

44. (153.) *CHARITONETTA ALBEOLA* (Linn.). 262.
Buffle-head.

Synonyms: *Clangula albeola*, *Bucephala albeola*, *Fuligula albeola*, *Anas albeola*.

Buffle-headed Duck, Butter Duck, Butter-ball, Dipper, Spirit Duck, Dipper Duck, Butter-box, Hell-diver.

Kirtland, Ohio' Geol. Surv., 1838, 166, 187.

The little Buffle-head is common during the migrations, both spring and autumn. It visits the smaller lakes and ponds, where it is oftener seen than on larger waters. It is not wary, trusting to its agility in diving for protection. There is no likelihood that it breeds within the state, but it may remain all winter in suitable localities well south.

Its migrations occupy the last week in March and the first two weeks in April. It appears to be less common during its southward migration, which begins early in October and continues well into November, or later.

45. (154.) *HARELDA HYEMALIS* (Linn.). 263.
Old-squaw.

Synonyms: *Harelda glacialis*, *Anas glacialis*, *A. hyemalis*, *Clangula hiemalis*, *C. hyemalis*.

Long-tailed Duck, Old-wife, South-southerly.

Wheaton, Ohio Agri. Report, 1860, 370, 378.

This is a winter duck, sometimes passing to the southern border of the state. It is not at all regular even in the northern part, and does not appear to be governed wholly by weather conditions. During some winters it is decidedly numerous anywhere on the lake front, and may venture well inland upon the smaller lakes and reservoirs, to the Ohio river, and several winters may pass without another visitation. Specimens have been taken from the gill nets off Lorain in five fathoms of water where they had dived for fish and became tangled in the nets and drowned. Several spent the winter of 1901-02 on the lake shore in Lorain county.

46. (160.) *SOMATERIA DRESSERI* Sharpe. —.
American Eider.

Synonyms: *Somateria mollissima dresseri*.

Davie, Nests and Eggs of N. Am. Birds, 1898, 92.

The specimen here reported by Mr. Davie was captured at the Licking reservoir, November 11, 1895, by Mr. William Harlow. The specimen is a female and is preserved in the private collection of Mr. Davie.

The fact that this species has been found a number of times well inland makes it necessary to regard it a casual rather than an accidental visitor to the state.

47. (162). *SOMATERIA SPECTABILIS* (Linn.). 264.
King Eider.

Synonyms: *Anas spectabilis*.

Wheaton, Ohio Agri. Report, 1860, 370, 378.

I have been unable to find any later records for the occurrence of this species in Ohio than those given by Dr. Wheaton in his catalogue of 1882, 535. They are: An immature bird taken at Sandusky bay (?), by Dr. Langdon during the winter of 1877-8; one found in the Columbus market, November 4, 1880, by Dr. Wheaton; and the statement that a specimen was taken at Sandusky bay and one at Cleveland "many years since," on the authority of Mr. R. K. Winslow.

48. (163). *OIDEMIA AMERICANA* Swains. 265.
American Scoter.

Synonyms: *Oedemia americana*.

American Black Scoter, Sea Coot, Butter-billed Coot, Hollow-billed Coot.

Merriam, Trans. Conn. Acad., IV, 1877, 127.

There seem to be four records of the occurrence of this species in the state. Licking reservoir, December, 1876, in Dr. Theodore Jasper's collection in Columbus; taken on Portage river by Mr. R. K. Winslow; one taken from a flock of three on Lake Erie, by Mr. H. E. Chubb; Alum

Creek, Columbus, December 3, 1895, in the collection of Oliver Davie, Columbus.

It seems pretty clear that this is a casual winter visitor.

49. (165.) *OIDEMIA DEGLANDI* Bonap. 266.

White-winged Scoter.

Synonyms: *Melanetta velvetina*, *Ædemia fusca* (var.?) *velvetina*, *Ædemina fusca*.

Velvet Scoter, White-winged Surf Duck, White-winged Coot, Black Surf Duck, Velvet Duck, Sea Coot

Wheaton, Ohio Agri. Report, 1860, 370, 378.

Dr. Wheaton states that Mr. R. K. Winslow recorded the occurrence of this duck at Cleveland and Sandusky bay. The records which are based upon specimens captured are: one taken on the Scioto river near Columbus, and an immature bird taken at the Licking reservoir in December, 1876, both specimens having been examined by Dr. Wheaton. There are two specimens in the Oberlin College collection, one taken April 27, the other May 3, 1892, by Harry Warden, of Lorain. These specimens were taken at Lorain.

One might judge from these records that this scoter is a rare migrant across the state, or possibly a winter visitor. It is rare at any rate.

50. (167). *ERISMATURA JAMAICENSIS* (Gmel.). 267.

Ruddy Duck.

Synonyms: *Erismatura rubida*, *Fuligula rubida*, *Anas rubida*.
Black Jack, Bristle-tail, Fool Duck.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

My experience with this small duck proves that at Oberlin it is almost as numerous as the Bufflehead on the waterworks reservoir. It is seen there regularly every spring and autumn in twos and fours, rarely more, and is even less wary than the Bufflehead. There is no evidence of the breeding of this species in the state. It is reported as not common by most observers. It is probably somewhat local in its distribution.

They reach Oberlin about the middle of April and may linger until the 10th of May. The return is early in October and some remain a month or six weeks.

Subfamily ANSERINÆ. Geese.

There are six species of geese in the state, none of them really common now, none of them breeding here. They are much more terrestrial than any of the ducks, feeding upon grains and the green herbage. In the water they feed like river ducks (by tipping up, searching the bottom of a shallow pool for the roots and fruit of aquatic plants). They fly in regular order with a leader.

51. (169.) CHEN HYPERBOREA (Pall.). 243 (part).
Lesser Snow Goose.

Synonyms: Chen hyperboreus, Anser hyperboreus, Chen hyperboreus albatius.

Alaska Goose, White Brant.

There is no published record of this species as an Ohio bird. Reports give it as rare in Allen, Erie, Hamilton, and Perry counties. Everywhere it is reported as rare, and as usually occurring in company with the other species.

52. (169a.) CHEN HYPERBOREA NIVALIS (Forst.). 243 (part).
Greater Snow Goose.

Synonyms: Chen hyperboreus Anser nivalis, A. hyperboreus. Snow Goose, Alaska Goose, White Brant.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

This larger species seems to be no more common than the last. It is reported from Scioto, Pike, Perry, Hamilton, and Erie counties. These Snow Geese are too conspicuously different from the other geese to make any mistake of identification possible. It is very desirable that specimens in the collections be critically examined to determine the status of each form.

53. (169.1.) *CHEN CÆRULESCENS* (Linn.). 242.
Blue Goose.

Synonyms: *Anser cærulescens*.
Blue Snow Goose.

Wheaton, Ohio Agri. Report, 1874, 574.

This peculiarly colored goose is not so rare as was supposed before Dr. Wheaton's catalogue called attention to it. It is not a regular visitor to any locality, but may be found anywhere in the state where there is water sufficient to sustain aquatic life and afford feeding grounds. Two were captured on the Oberlin water-works reservoir, October 28, 1896. It is a migrant across the state, the most of the records falling in October.

54. (171a.) *ANSER ALBIFRONS GAMBELI* (Hartl.). 244.
American White-fronted Goose.

Synonyms: *Anser albifrons*, *A. gambelii*.
Laughing Goose, Gray Brant, Speckle-belly.

Kirtland, Ohio Geol. Surv., 1838, 166, 186.

This goose is rare as a migrant across the state, but is reported as a rare winter resident in Hamilton county. Mr. Ridgway states that it frequents open fields and feeds upon the scattered grain and tender blades of growing grain. Little seems to be known of it as a bird of Ohio.

55. (172.) *BRANTA CANADENSIS* (Linn.). 245.
Canada Goose.

Synonyms: *Bernicla canadensis*, *Anser canadensis*.
Wild Goose, Common Wild Goose.

Audubon, Orn. Biog. III, 1835, 1.

This is the "Wild Goose" of the popular mind. In the vicinity of Oberlin it is not at all common as a migrant. Usually the season's records include one large flock during each migrating period, and possibly a single individual or two. It is resident all winter in southern Ohio, where it remains from November until April. It feeds in the open fields rather than in the water, being very much of a vege-

tarian. This goose may be domesticated with little difficulty, but measures should be taken to prevent its migration when the season approaches.

The migrations are not regular, but may begin late in February and continue well into April. Few or none are seen in autumn before the first touch of winter drives them south.

56. (172a.) *BRANTA CANADENSIS HUTCHINSII* (Rich.).
245a.

Hutchins Goose.

Synonyms: *Bernicla hutchinsii*, *B. canadensis hutchinsii*, *Anser hutchinsii*.

Lesser Canada Goose, Little Wild Goose.

Wheaton, Ohio Agri. Report, 1860, 370, 378.

Dr. Wheaton admitted this species to his list on the authority of Mr. R. K. Winslow, who stated that several specimens had been taken in Sandusky bay. No specimens seem to have been preserved. A live specimen in the possession of Mr. William Harlow, of Millersport, on Licking reservoir, has been carefully examined by Mr. W. L. Dawson, and proves to belong to this form. It was captured in the wild state and has been domesticated by Mr. Harlow.

Subfamily CYGNINÆ. Swans.

Two species of swans are found in the state, both of them during the migrations only. They are seldom seen, except when the weather conditions force them near the ground in their migrations, when flocks may be noticed during the northward movement. Such large birds, with such long slender necks, could not be expected to dive for food. They are not so undignified as to tip up, but simply immerse the head and neck to glean from the surface of the mud bottom. Their food is almost wholly vegetation, but some mollusks seem to be eaten sometimes.

57. (180.) OLOR COLUMBIANUS (Ord.). 240.
Whistling Swan.

Synonyms: Olor americanus, Cygnus americanus, C. musicus, C. columbianus, Anas columbianus.

Common American Swan, American Whistling Swan.

Kirtland, Ohio Geol. Surv., 1838, 166, 187.

During the spring of 1899 this swan was numerous in Lorain county where many were killed by hunters. It is a rare migrant in the state, seldom being seen in its passage unless stopped by stormy weather. Migration records are wanting.

58. (181.) OLOR BUCCINATOR (Rich.). 241.
Trumpeter Swan.

Synonyms: Cygnus buccinator.

Wheaton, Ohio Agri. Report, 1860, 369, 378; Reprint, 1861, 11, 20.

The Trumpeter Swan is even less numerous than the Whistling, but passes across the state in its migrations. It has been taken on Lake Erie several times within the past ten years. Very little seems to be known of it as an Ohio bird. This swan may remain in the state during the winter.

ORDER HERODIONES. Bitterns, Herons,
Storks, Ibises, Egrets.

SUBORDER CICONIÆ. Wood Ibis.

Family CICONIDÆ. Wood Ibis.

The single species comprising this family rarely wanders to the southern part of the state.

59. (188.) TANTALUS LOCULATOR Linn. 192.
Wood Ibis.

Synonyms: American Wood Stork, Colorado Turkey, "Gannet," "Water Turkey."

Wheaton, Reprint, Ohio Agri. Report, 1861, 21.

Apparently the only absolutely unquestionable record of

this bird's occurrence in Ohio is that of Mr. H. E. Chubb, of Cleveland, who mounted a young male which was captured ten miles west of Cleveland. Dr. Langdon's inferential record should not be omitted. Specimens captured on the Whitewater river in Indiana very likely followed that river to its junction with the Big Miami and so into Ohio.

SUBORDER HERODII. Bitterns, Herons, Egrets.

Family ARDEIDÆ. Bitterns, Herons, Egrets.

Subfamily BOTAURINÆ. Bitterns.

All the species comprising this group are found in the state. They are strictly swamp hunters, feeding and nesting there. They usually stand quietly and wait for the prey to come within striking distance, when they strike it with the strong, sharp-pointed bill. I have seen them pursue the frog or fish or tadpole. Apparently they eat any small animal which comes in their way in the swamps, except birds.

60. (190.) *BOTAURUS LENTIGINOSUS* (Montag.). 190.
American Bittern.

Synonyms: *Botaurus minor*, *Ardea minor*, *A. lentiginosus*.

Bittern, Indian Hen, Stake Driver, Bog-bull, Thunder Pump, Kirtland, Ohio Geol. Surv., 1838, 165.

The Bittern will not be known to those who do not go into the marshes and swamps. It is seldom seen on running streams, preferring the unfrequented swamps and bogs, feeding in the stagnant pools among the reeds and brush. It is reported as fairly common over the state, but will be absent from places lacking swampy ground, and therefore must be considered local in its distribution in summer. It is more frequently seen during the migrations than at any other time. While visiting in Medina in May, 1901, while out with a party of bird students on a wet morning, we saw a Bittern in an orchard in the heart of the residence district of the village. It permitted an approach within a rod, and

even then merely hopped into the foliage a little closer. Later I learned that we failed to see the young bird which was crouching in the grass. This bird is a summer resident, probably breeding throughout the state wherever suitable places may be found.

The first reach Oberlin late in March or early in April, and the last return south late in October.

61. (191.) ARDETTA EXILIS (Gmel.). 191.
Least Bittern.

Synonyms: *Ardea exilis*.

Kirtland, Ohio Geol. Surv., 1838, 165.

This little bittern is more local in its distribution than the last species. At the Licking reservoir it was the most numerous of the swamp haunting birds, but we were unable to find one at the Lewiston reservoir. It nests in the Sandusky bay swamps, and a pair has usually been found at the Oak Point swamps. Elsewhere I have no knowledge of it. The birds are so reluctant to leave their reedy retreats that it is no wonder few are seen by any but the ardent ornithologist. It is likely that this bittern breeds locally throughout the state, but the reports are not positive on that point.

The migrations are late in April or early in May, and the last return south by the middle of September.

Subfamily ARDEINÆ. Herons and Egrets.

Six species of this group are found in Ohio. All of them are wading birds and therefore feed in shallow water. They choose more open water than the bitterns, trusting more to watchfulness and stalking for their food. Their nests are built in trees or bushes instead of in the rushes, and the birds are found among the trees. Their colors do not blend so perfectly with their surroundings. Their food is much the same as that of the bitterns.

62. (194.) ARDEA HERODIAS Linn. 185.

Great Blue Heron.

Synonyms: Blue Crane.

Kirtland, Ohio Geol. Surv., 1838, 165.

This, the largest of our herons, is being jostled about at an alarming rate as its wooded retreats disappear. It is a summer resident in all parts of the state, but the large heronries once accommodating great numbers of pairs are either greatly reduced or wholly destroyed. I have reports of a great heronry at Richmond, and another, already reduced to half its former size, some eight miles southeast of Jefferson. The water is being drained off and the trees made into lumber, and the birds must go. In Lorain county half a dozen pairs nest each year, but there is no apparent increase in numbers from year to year. Their nesting retreats have not yet been discovered, so they are likely to remain in peace for some time.

Unlike the bitterns, the herons prefer either running water or stagnant water free from much growing vegetation. The Great Blue feeds mostly from the fish nets in Lake Erie, taking the fish out of the "pounds." Batrachians are captured in the streams and ponds, and some grasshoppers are used to vary the diet.

The first reach Oberlin about March 20th, and the last return south about the middle of October.

63. (196.) HERODIAS EGRETTE (Gmel.). 186.

American Egret.

Synonyms: Herodias alba egretta, Ardea egretta.

Great White Egret, Great White Heron, White Crane.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

Dr. Wheaton wrote of this heron, "Rather common visitor in July, August, and September." It is now not only not common, but any record is counted worthy of special mention. Specimens have been taken in Erie, Lorain, Cuyahoga, and Ashtabula counties in recent years, besides the numerous records from counties farther south. Dr. Whea-

ton knew of no breeding records, but spoke of seeing young birds. His statements seem to indicate that he regarded the occurrence of this heron in Ohio as the result of a northward migration after the breeding season. I have been unable to find any actual breeding records. One of the two Lorain county specimens, taken by Mr. R. E. Jump, near Oberlin, was found during the spring. The majority of occurrences seem to fall in July and August.

64. (197.) *EGRETTA CANDIDISSIMA* (Gmel.). 187.
Snowy Heron.

Synonyms: *Garzetta candidissima*, *Ardea candidissima*.
Little White Egret.

Wheaton, Ohio Agri. Report, 1860, 368, 377.

The occurrence of this heron in the state nearly duplicates that just given for the American Egret. While every record is regarded as practically accidental for that county in which the record falls, it is significant that the records cover practically all of the state except the extreme northwestern and extreme southeastern parts. On the lake shore, Erie, Lorain, Lake, Ashtabula; inland, Licking, Hardin, Defiance; and Hamilton on the southwestern border are certainly representative of the whole state. With our present knowledge of this bird we must regard it as rare and irregular as a summer visitor.

65. (200.) *FLORIDA CÆRULEA* (Linn.). —.
Little Blue Heron.

Synonym: *Ardea cærulea*.

Entered as hypothetical by Wheaton, Reprint, Ohio Agri. Report, 1861, 21, and also in his 1882 Catalogue. Also as hypothetical by Langdon, Cat. Birds of Cin., 1877, 15. The first published record of this species as unquestionably a bird of Ohio is as follows:

McCormick, L. M., Auk, X, Oct., 1892, 397. Record of a bird captured near Oberlin by Mr. R. E. Jump, about 1882.

The distribution of this little heron in Ohio is hardly less irregular than that of the two egrets. Since the publication of the Lorain county specimen others have been taken in

Hamilton (Dury and C. C. Smith), Morgan (Morris and Arrick), where it was found breeding, Ashtabula (Sim), Perry (DeLong), Pike (Henninger). Reports from Columbiana and Defiance clearly refer to the Green Heron. The movements of this heron are too erratic to make predictions of its probable occurrence worth while.

66. (201.) *BUTORIDES VIRESCENS* (Linn.). 188.
Green Heron.

Synonyms: *Ardea virescens*.
Fly-up-the-creek, Shytepoke.

Kirtland, Ohio Geol. Surv., 1838, 165.

This is the common and well-known heron in Ohio. It is common and breeds everywhere in the state where there is water enough to furnish food and trees or other cover enough to hide the nest and young. In Lorain county it frequently nests in orchards bordering swamps, or in the thick second growth on a hillside.

The Green Heron consumes quantities of grasshoppers, and probably other large insects, besides its diet of tadpoles and water insects, and small batrachians. It is too useful to be persecuted for its ungainly carriage.

The first reach the state during the last week in April, usually, and the most have gone south by the first of October, but individuals may tarry even after the middle of November where the fishing is good.

67. (202.) *NYCTICORAX NYCTICORAX NÆVIUS*. (Bodd.). 189.
Black-crowned Night Heron.

Synonyms: *Nyctiardea grisea* var. *nævia*, *Ardea discors*, *Nyctiardea gardneri*, *Ardea nævia*.

Night Heron, Quawk, Squawk, Qua-bird, American Night Heron, Night Raven.

Kirtland, Ohio Geol. Surv., 1838, 165, 184.

This heron is locally common in the state, but seems to be absent from many regions. It is a summer resident wherever it is found. Its semi-nocturnal habits probably

account for its apparent absence from many places where it should breed. It is another of the swamp loving birds, nesting in the trees and bushes which grow in the swamps or in wet places.

Migration dates are lacking. It is likely that it winters in some favorable places in the state. Observers should be on the lookout for it.

ORDER PALUDICOLÆ. Cranes, Rails, Coots, Gallinules.

SUBORDER GRUES. Cranes.

Family GRUIDÆ. Cranes.

All three of the North American cranes have been found in Ohio, one of them having wandered from the west. In general appearance the cranes show a marked resemblance to the herons, but the space in front of the eye is covered with bristles instead of being bare. While migrating they fly in long files. They are not such strict marsh haunters as the herons, but frequent uplands also. They are omnivorous feeders, often swallowing indigestible matter and disgorging it after a time. Frogs, lizards, snakes, field-mice and probably insects, and vegetable food are eaten with equal relish apparently.

68. (204.) *GRUS AMERICANA* (Linn.). 238.

Whooping Crane.

Synonyms: *Ardea americana*.

White Crane.

Kirtland, Ohio Geol. Surv., 1838, 165.

The reports of the occurrence of this bird come from the western half of the state, where it appears to be a rare migrant.

I find no dates of migration. Judging from the migrations in Iowa at nearly the same latitude, they should be seen passing northward in a long thin line during the last week in March and the first week in April.

69. (206.) *GRUS MEXICANA* (Müll.). 239.
Sandhill Crane.

Synonyms: *Grus canadensis*, *Ardea canadensis*, *A. mexicana*.
Brown Crane, Southern Sandhill Crane, Common Brown Crane.

Wheaton, Ohio Agri. Report, 1860, 370, 480.

While this crane is by no means common it is rather more numerous than the preceding species. It has been found breeding at Chicago Junction, and near Toledo. The eggs taken at Chicago Junction were successfully hatched and the young reared and kept in captivity until their natural death. One of the three birds of this lot was preserved by Mr. E. E. Masterman, of New London, and is now in the Oberlin College museum. It is a fine large bird in almost perfect plumage.

The migrations should occur at the same time as those of the Whooping Crane. The cranes may be distinguished from other birds in flight by the manner of flight. After perhaps ten deliberate wing strokes there is a period of soaring flight of nearly the same duration, then another beating of the wings followed by a soaring, and so on. When the birds settle too close to the ground in this straight-away flight they circle upward by means of the same style of flight as when going straight ahead. At intervals they croak in concert, creating a disturbance that must arrest attention. In flight, legs and neck are stretched out at full length.

SUBORDER RALLI. Rails, Gallinules, Coots.

Family RALLIDÆ.

In food habits the species comprising this family agree in general. All eat seeds, tender vegetation, worms, insects, crustaceans, mollusks, and with these some rubbish. The rails and gallinules live in the swamp vegetation very largely while the coots live and feed more in the open water and are therefore more often seen. The rails are averse to leaving the cover of the grass, and will do so only when suddenly

disturbed. They are so protectively colored, and know so well how to assume protective attitudes, that they have small need to leave their covers.

70. (208.) *RALLUS ELEGANS* Aud. 231.

King Rail.

Synonyms: Fresh-water Marsh Hen, Red-breasted Rail.

Wheaton, Ohio Agri. Report, 1860, 369, 378.

Inland this does not appear to be a common bird, but in shallow ponds or lagoons near the lake it is common. It is probably a summer resident wherever it occurs in the state, nesting in the marshes.

It reaches Oberlin about the first of May, but I have no records for the southward migration.

71. (212.) *RALLUS VIRGINIANUS* Linn. 232.

Virginia Rail.

Nuttall, Man. II, 1835, 205.

This is probably the most common of the rails along the lake front where it is found in every marsh of any extent, and may even resort to wet meadows to nest. He is so sly and so hard to flush in spring that few but those who are on the lookout and know where to find him realize his presence. The nest is generally placed on a hummock formed by the roots of a bush or tuft of grass in the marsh, often without concealment. In movement this bird resembles a chicken, just as the King Rail resembles a hen. It is less common than the Sora away from the lake marshes, becoming even rare as a summer resident near our southern border.

The Virginia Rail reaches Lorain county about the first of May, and has gone south by the middle of September.

72. (214.) *PORZANA CAROLINA* (Linn.). 233.

Sora.

Synonyms: *Rallus carolinus*.

Carolina Rail, Ortolan, Crake, Carolina Crake, Common Rail. Kirtland, Ohio Geol. Surv., 1838, 165, 185.

The Sora is a fairly common inhabitant of the marshes and wet meadows wherever they occur in the state. It appears to be a little less numerous south than north. It frequently nests in wet meadows or in the tall grass bordering ditches. During the migrations it not infrequently strikes buildings or wires or other obstructions, and is either killed or hurt or dazed and is brought to notice more frequently than any of the other rails in this way. One that had been injured in the breast was found in the court of Peters Hall, Oberlin, when the building was opened in the morning. There had been no open doors or windows, nor any broken window where it might have entered. Its appearance there could not be accounted for unless it had squeezed under a door in the basement.

The Sora reaches Oberlin shortly after the first of May, according to my records. It probably arrives earlier but is unnoticed at first. I have no records of its departure southward, but since the date of capture of the one mentioned above was October 23, 1896, it seems likely that the departure is not far from that date.

73. (215.) PORZANA NOVEBORACENSIS (Gmel.). 234.
Yellow Rail.

Synonyms: *Rallus noveboracensis*, *Fulica noveboracensis*.

Yellow-breasted Rail, Upland Rail, Yellow Crake, Little Yellow Rail.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

This little rail is reported as rare in the six *counties where it has been found. There is good reason to believe that it is much more numerous than the records show, because it is both so small and so hard to flush from its reedy retreats that we almost never see it. Systematic search should reveal it in many localities where it has never been seen.

I can find no records of nests actually found within the state, but the dates upon which many specimens have been found clearly indicate that this rail breeds in the northern part of the state at least.

*Ashtabula, Cuyahoga, Erie, Hamilton, Lorain, Portage.

74. (216.) PORZANA JAMAICENSIS (Gmel.). —
Black Rail.

Synonyms: *Rallus jamaicensis*.

Little Black Rail, Little Black Crake.

Entered as hypothetical by Dr. Wheaton in his 1882 Catalogue on the authority of Dr. Langdon, whose record was also hypothetical. The first published record must therefore stand as follows:

Dury, Charles, *Journal Cin. Soc. Nat. Hist.*, 13, July, 1890, 97.

This specimen, one of two seen, was captured near Carthage, May 17, 1890, at Ross Lake. I find no other authentic record.

75. (218.) IONORNIS MARTINICA (Linn.). 235.
Purple Gallinule.

Synonyms: *Porphyrio martinica*, *Gallinula martinica*, *Fulica martinica*.

Wheaton, *Ohio Agri. Report*, 1860, 369, 378, hypothetical. The first unquestioned record seems to be as follows:

Wheaton, *Bull. Nut. Orn. Club*, II, 1877, 83. Specimen captured by Dr. Howard E. Jones, at Circleville, May 10, 1877.

The first specimen captured in the state of which we have any record seems to be that reported to Dr. Wheaton. "Dr. Hunt informs me of the capture of this species near the mouth of the Big Miami river, on March 31, 1877." "Two specimens * * * * have since been taken at Madisonville, one by the writer in the latter part of April, and another by Mr. William H. Whetsel, early in May. Mr. John W. Shorten also reports one killed May 1, at Jones' Station (about thirty miles from Cincinnati), by J. H. Kelly, Esq." (Wheaton.)

Prof. E. L. Moseley reports a specimen captured at Sandusky bay, April 28, 1896; Dr. Carl Tuttle, one which had flown against the telegraph wires and was killed, "along the lake shore," September 2, 1894 (*Auk* XII, 191).

No other records than these have come to my knowledge.

76. (219.) *GALLINULA GALEATA* (Linn.). 236.
Florida Gallinule.

Synonyms: *Gallinula chloropus*, *Crex galeata*.

Common Gallinule, Red-billed Mud-hen.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

This rather conspicuous swamp bird is fairly common over the entire state where there are marshes large enough to accommodate it. In many of the larger swamps it is almost abundant. At Licking reservoir we found it in considerable numbers. At the Sandusky bay marshes it is more than common. I have not found it at the small swamps at Oak Point. A few were to be found at Lorain before the ship yards were established there. It does not flush readily from its retreats, but makes such a disturbance when running through the reeds and grasses that it can readily be traced by sound. In the vicinity of the young it is possible to approach within studying distance of the parents.

They first reach northern Ohio about the first of May, and the last is seen about the middle of September.

77. (221.) *FULICA AMERICANA* Gmel. 237.
American Coot.

Synonyms: Coot, Mud-hen, Crow Duck, White-billed Mud-hen. Wheaton, Ohio Agri. Report, 1860, 369.

While the Coot is more often seen than the Florida Gallinule by the casual bird student, it is not as numerous in individuals in the state. It generally visits the Oberlin water-works reservoir during both migrations, and may visit the open water and ponds in the vicinity of the lake shore at such times. If it remains all winter in the southern counties it does so rarely. It was not found breeding at either the Licking or Lewiston reservoirs, nor at Chipewa lake, but one bird was seen by me at the Sandusky bay swamps in July. It appears to breed sparingly in our most northern marshes, but is not generally common in summer.

The Coot enters the state late in March, reaches the lake

shore soon after the first of April, and returns south again during late October.

ORDER LIMICOLÆ. Shore Birds.

The Shore Birds very largely subsist on such animal food as may be found in the soft mud or along the borders of streams and ponds or on the shore of lake or ocean. All species found in Ohio except the Plovers probe the mud for the worms, insects and their larvæ, mollusks and other small animals found there, but the Plovers glean mostly from the surface and may also take some vegetable matter. They are decidedly useful birds, keeping in check insects which other birds would not destroy.

Family PHALAROPODIDÆ. Phalaropes.

Two of the three species of this family are found in Ohio, and the other one may yet be discovered. At best they are unusual and wary, wading in the water and swimming on its surface with ease.

78. (223.) PHALAROPUS LOBATUS (Linn.). 227.

Northern Phalarope.

Synonyms: *Lobipes hyperboreus*, *Phalaropus hyperboreus*, *Tringa lobata*.

Red-necked Phalarope.

Kirtland, *Am. Journal Sci. and Arts*, XL, 1841, 21.

I have been unable to add any records of this species to those given by Dr. Wheaton, which are as follows: A single specimen (not a pair) taken near the pier in Cleveland harbor in November, 1840 (?), and preserved in Dr. Kirtland's collection. A pair taken by Dr. Jasper, on the Scioto river, also in winter plumage, one of them preserved in Dr. Wheaton's, the other in Oliver Davies' collection. Dr. Wheaton also remarks that others have been taken by Mr. R. K. Winslow and others on the lake shore. The status of the species as an Ohio bird must rest upon the three captured specimens.

79. (224.) *STEGANOPUS TRICOLOR* Vieill. 228.

Wilson Phalarope.

Synonyms: *Steganopus wilsoni*, *Phalaropus wilsonii*, *Phalaropus tricolor*.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

This phalarope is reported only from Erie county where it is stated it may breed. It has been found in Lorain county three times, each time during the first week in May. While it may breed in the north-western part of the state there is no record of its doing so.

The few notes upon its migration seem to indicate that it reaches the northern counties soon after the first of May. A more careful search for this interesting bird should discover it in many places where it is not known at present. It is wary and difficult to approach.

Family RECURVIROSTRIDÆ. Avocets and Stilts.

Both North American members of this family have been found in the state. They are also rare, and, like the last family, are waders. They do not swim as well, since their toes lack the lobes on their sides.

80. (225.) *RECURVIROSTRA AMERICANA* Gmel. 229.

American Avocet.

Kirtland, Ohio Geol. Surv., 1837, 166 185.

The rarity of this species in the state is attested by the paucity of reports of its occurrence. Dr. Wheaton placed it upon his list on the authority of Dr. Kirtland, who reported specimens that had been killed near Cincinnati by sportsmen. Mr. Charles Dury makes this later record, "Has been seen on sandbar of Ohio river." Mr. A. Hall "saw a specimen taken near Cleveland." Rev. W. L. Dawson informs me of a specimen secured at St. Mary's reservoir, Nov. 10, 1882, by Mr. Clemens Utter, which is now in the collection of the State University. Mr. R. W. Smith reports "One specimen, in winter plumage, taken at Lebanon

reservoir, in the spring of 1880, and now in Mr. Gould's collection."

This exhausts what we know of the Avocet as an Ohio bird.

81. (226.) *HIMANTOPUS MEXICANUS* (Mull.). 230.
Black-necked Stilt.

Synonyms: *Himantopus nigricollis*, *Charadrius mexicanus*.
Stilt, Long-shanks, Lawyer.

Langdon, Journal Cin. Soc. Nat. Hist., I, 1879, 182.

The above citation rests upon the authority of Mr. Dury. Dr. Wheaton also states that "The Stilt has been repeatedly taken on Lake Erie, as I am informed by Mr. Winslow." There are no more recent records.

Family *SCOLOPACIDÆ*. Snipes, Sandpipers, etc.

Ohio is credited with twenty-seven members of this varied family. The Woodcock is strictly sylvan, found nowhere but in the wet woods. Many are shore haunters, some feed in wet meadows, and most of them are likely to be found in or around the field ponds and spring flooded places where the water stands for a few days or weeks. All have sensitive bills with which they are able to feel the worm or insect in the mud, and some are able to move the tip of the bill without moving the rest of the bill. Some travel in flocks of varying size while some are solitary. Reference to the individual species will discover other points which it would not be possible to treat here.

82. (228.) *PHILOHELA MINOR* (Gmel.). 200.
American Woodcock.

Synonyms: *Scolopax minor*.

Bog-sucker, Big Mud Snipe, Big-headed Snipe, Blind Snipe, Whistling Snipe, Timber Doodle, Bog Bird, Night Partridge, Night Peck, Hookum Pake, "Pewee," Labrador Twister, Whistler.

Kirtland, Ohio Geol. Surv., 1838, 165.

The Woodcock is too much sought after and therefore

too well known as a game bird to pass unnoticed in any locality. It is generally reported as being a fairly common breeding bird throughout the state. Naturally it is more numerous in wet or damp woods than elsewhere, and may become even abundant in restricted localities which afford it both cover and abundant food. Being semi-nocturnal, it must be flushed to be seen during the day. At twilight one may be favored with the so-called song and peculiar mazy dancing flight during the mating season, in regions where the birds are numerous.

Woodcock is the only woods-haunting bird which probes deep into the mud for the worms and insect larvæ which lurk there. It therefore performs an office as an insect destroyer which is shared by no other bird. As its name implies, it is strictly sylvan, seldom venturing out of the brushy retreats except to pass from woods to woods, or during the mating flight.

One would naturally expect a bird which depended upon mud-inhabiting insects for food to tarry south until warm weather insured an abundant supply of its food; but the Woodcock reaches Oberlin during the last week in March at the latest, often by the middle of that month, and does not return south until early November.

83. (230.) *GALLINAGO DELICATA* (Ord). 201.
Wilson Snipe.

Synonyms: *Gallinago wilsoni*, *G. media wilsoni*, *Scolopax wilsonii*, *S. delicata*.

American Snipe, Jack Snipe.

Kirtland, Ohio Geol. Surv., 1838, 165.

The Jack Snipe is still an abundant migrant in some localities, but is becoming scarce in others. It is the mud prober of the fields and treeless bottom lands, complementing the work of the Woodcock. There can be no doubt that this snipe does good service for the farmer in ridding his wet fields of the insect larvæ which burrow there ready for the young crop soon to appear. It is a pity that the erratic flight of the snipe offers so many temptations to the sportsman,

and his flesh to the epicure. He is a necessary factor in the economy of agricultural science.

Reports of the breeding of this species in several counties pretty clearly indicate mistaken identification of the bird. So far as I have been able to judge, there are still no authentic records of nests or young actually found in the state. It may yet be found breeding in the north-western counties, and possibly elsewhere.

There is unmistakable evidence that this snipe sometimes winters in the state. Prof. E. L. Moseley records them in winter some miles west of Sandusky where springs prevent the freezing of the mud and water. In the southern counties there are January records which can hardly be migrating birds.

The first migrants reach Oberlin about the first of April, and some remain well into May. Their return in autumn is too irregular to make any definite statements possible, except that the last tarry well toward the end of October.

84. (231.) *MACRORHAMPHUS GRISEUS* (Gmel.). 202.
Dowitcher.

Synonyms: *Scolopax grisea*.

Red-breasted Snipe, Gray Snipe, Gray-back, Gray-backed Snipe, Long-billed Dowitcher, Brown-back.

Kirtland, Ohio Geol. Surv., 1838, 165.

Judging from the reports, it is a decidedly rare bird in Ohio. Dr. Langdon and Mr. Dury report it without comment as rare near Cincinnati, and Prof. Moseley reports it rare without comment at Sandusky. It is not mentioned by others. It has never been taken in Lorain county.

It should be looked for in April and May, and again in late July, in August and probably in September.

85. (232.) *MACRORHAMPHUS SCOLOPACEUS* (Say.). 202a.
Long-billed Dowitcher.

Synonyms: *Macrorhamphus griseus scolopaceus*, *Limosa scolopacea*.

Western Dowitcher, Red-bellied Snipe, Greater Long-neck. Wheaton, Ohio Agri. Report, 1884, 1875, 572.

There seemed to be considerable confusion in Dr. Wheaton's mind regarding the two Dowitchers, since this species was not included in the body of his catalogue, but was given a place in his check-list. It seems likely that his *M. griseus* covered this species which was then regarded as a subspecies. I have but two specific references to this species, both from Cincinnati. Mr. William Hubbell Fisher has permitted me to examine a specimen in his private collection, and Mr. Charles Dury reports it as rare. If there be other specimens in collections they have not been brought to my notice. Its normal range would seem to lie west of Ohio, although the other species is the rarer in Indiana, according to Butler.

86. (233.) MICROPALAMA HIMANTOPUS (Bonap.). 203.
Stilt Sandpiper.

Synonyms: *Tringa himantopus*.

Wheaton, Ohio Agri. Report, 1874, 1875, 572.

Dr. Wheaton admits it to his catalogue on the authority of Mr. Winslow. Mr. A. Hall enters it as "Very rare," near Cleveland. The only other record is the following: Forest and Stream, XXXIII, No. 1816, p. 265 (?). Dr. E. Sterling. 1889.

87. (234.) TRINGA CANUTUS Linn. 204.
Knot.

Synonyms: Red-breasted Sandpiper, Gray-back, Robin Snipe, May Bird, Ash-colored Sandpiper, White-bellied Snipe, Silver-back, Red-breast Plover, Beach Robin, Horse-foot Snipe, Robin-breast, White Robin Snipe, Red Sandpiper, Blue Plover.

Wheaton, Ohio Agri. Report, 1860, 380, hypothetical. The first published record of a specimen actually taken seems to be the following:

Wheaton, Ohio Geol. Surv., 1882, Vol. IV, Pt. 1, 478.

"Mr. Ed. Savage, of this city, captured a fine male, of a pair in full breeding plumage, at the Licking reservoir, May 27, 1878."

Prof. E. L. Moseley, of Sandusky, is the only contributor to report it.

88. (235.) *ARQUATELLA MARITIMA* (Brünn.). 205.
Purple Sandpiper.

Synonyms: *Tringa maritima*.

Wheaton, Ohio Agri. Report, 1860, 380, hypothetical.

Apparently the only specimen actually captured in the state is that reported by Mr. Winslow from near Cleveland, which he says was preserved in the collection of the Cleveland Academy of Sciences.

89. (239.) *ACTODROMAS MACULATA* (Vieill.). 206.
Pectoral Sandpiper.

Synonyms: *Tringa maculata*.

Grass Snipe, "Jack Snipe," Krieker.

Wheaton, Ohio Agri. Report, 1860, 369.

This distinctively field sandpiper is fairly common as a migrant in all parts of the state. It may be abundant at some times during the migrations. It travels in flocks of from half a dozen to fifty or more birds which move as one bird. In general habits these birds resemble the plovers more than the sandpipers, apparently gleaning as well as probing for food. They must be classed as true benefactors to the farmer.

The first migrants reach Oberlin about the middle of April, and some tarry into the first week of May. The first return late in July and some remain about the wet bottom-lands until the first of October.

90. (240.) *ACTODROMAS FUSCICOLLIS* (Vieill.). 207.
White-rumped Sandpiper.

Synonyms: *Actodromas bonapartii*. *Tringa bonapartii*. *Tringa fuscicollis*.

Bonaparte's Sandpiper.

Wheaton, Ohio Agri. Report, 1860, 369.

In spite of the statement by Dr. Wheaton that this sandpiper is a "not uncommon spring and fall migrant on Lake

Erie, rare in the interior of the state," there remain only the records mentioned by him in his 1882 catalogue. Dr. Wheaton found it once, "in a locality known as the 'Broom-corn' fields, near Shadeville in Franklin county, late in October, 1875." Dr. Langdon's record follows: "Two specimens, the first recorded for this vicinity, taken September 6, 1879, near Glendale, Ohio, by Mr. J. B. Porter; both were males." The records of Mr. R. K. Winslow must be discounted, in the absence of specimens.

Bird students should be on the lookout for this species, which should be found in some numbers in the state.

91. (241.) *ACTODROMAS BAIRDII* Coues. 208.
Baird Sandpiper.

Synonyms: *Tringa bairdii*.

Wheaton, Ohio Agri. Report, 1874, 572.

While this sandpiper is reported by Mr. Dury alone of all those who have handed lists to me, it cannot be as rare as that would indicate. It has been taken in Lorain county several times during its southward migration, but never in spring that I am aware of. It should be found in some numbers with the other sandpipers. Probably the whole trouble is that none know the bird in the field. The winter plumage is not as distinctive as one could wish, but identification is not difficult.

92. (242.) *ACTODRAMAS MINUTILLA* (Vieill.). 209.
Least Sandpiper.

Synonyms: *Tringa minutilla*, *T. wilsonii*.

Kirtland, Ohio Geol. Surv., 1838, 165.

The Least Sandpiper usually reaches Oberlin in flocks after May 10. It is easily approached and readily identified, yet few seem to know it. I have always found it along the borders of ponds probing in the mud, or bathing in the water's edge. It was found in considerable numbers by Mr. Dawson and myself on Middle Bass Island during the first week in August, 1901. I have not seen it in the southward migration in Lorain county.

93. (243a.) *PELIDNA ALPINA PACIFICA* (Cous). 210.
Red-backed Sandpiper.

Synonyms: *Tringa alpina* var. *americana*, *Pelidna alpina americana*, *P. pacifica*, *Tringa schinzii*.

American Dunlin, Black-breast, Black-bellied Sandpiper, Ox Bird.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

There has apparently been a considerable decrease in the numbers of this species since Dr. Wheaton prepared his catalogue. It is nowhere given as common in the state. It is rare in Lorain county at any time of year, but has been recorded more often in the autumn than during the spring migrations. It is strictly a migrant across the state.

Migration dates are too few to be of service in determining the time of migration, but they indicate a northward movement during late April or early May, continuing well toward the close of May; and a return late in September or early October.

94. (246.) *EREUNETES PUSILLUS* (Linn.). 211.
Semipalmated Sandpiper.

Synonyms: *Ereunetes petrificatus*, *Tringa pusilla*.
Peep.

Wheaton, Ohio Agri. Report, 1860, 369.

This and the Least Sandpiper might easily be confused by any one not familiar with the two species. The difference in size would hardly be apparent unless the birds were near together. It is reported generally as not common during the migrations, but may be in some localities during favorable seasons. They often mingle with the Least Sandpipers in the fall at the common feeding-grounds of the shore birds. Both species, with many others, were recorded at the lagoon on Middle Bass Island during the first week of August, 1901, by Mr. Dawson and myself.

They appear to migrate somewhat earlier than the Least Sandpipers, in spring, but may return with them.

95. (248.) *CALIDRIS ARENARIA* (Linn.). 212.
Sanderling.

Synonyms: *Tringa arenaria*.

Ruddy Plover, Beach-bird.

Wheaton, Ohio Agri. Report, 1860, 480.

This light colored sandpiper is often common along the lake shore during both migrations. It appears to be less common in the interior of the state, but should be found on the gravelly beach of lake or large pond or reservoir. In flight the flocks are compact and move as one bird. I saw eleven killed from a flock of less than thirty birds with one discharge of the shot-gun. I have never seen the birds except in flocks of from six to fifty individuals.

The food consists largely of the insects washed ashore by the waves, and any other fragments of animal matter which the birds care for. They seldom run out on the beach far from the water, but depend largely upon the waves for food.

It passes through Lorain county during May, rarely tarrying into the first week of June, and returns by the middle of August, remaining well toward October.

96. (249.) *LIMOSA FEDOA* (Linn.). 213.
Marbled Godwit.

Synonyms: *Limosa fæda*, *Scolopax fedoa*.

Great Marbled Godwit, Doe Bird, Dough Bird, Marlin.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

I am able to add nothing to Dr. Wheaton's records of this bird in the state. "Dr. Kirtland notes its capture in several instances in northern Ohio. Mr. Langdon states on the authority of Mr. Dury, that thirty-three were 'shot in one day, near the mouth of the Little Miami, some years ago, by Charles Weeks, Esq.' A specimen was taken by a son of Dr. Jasper in the immediate vicinity of this city (Columbus), April 21, 1879." The wariness of the shore birds and the absolute necessity of securing specimens of most of them to make the identifications sure, are reasons which make the records of so many so unsatisfactory.

97. (251.) *LIMOSA HÆMASTICA* (Linn.). 214.
Hudsonian Godwit.

Synonyms: *Scolopax hæmastica*.

Smaller Doe-bird, American Black-tailed Godwit, Ring-tailed Marlin.

Kirtland, Ohio, Geol. Surv., 1838, 165, 185.

The records which Dr. Wheaton gives for this species are all that I have been able to find. "Dr. Kirtland notes its capture in the vicinity of Cincinnati, and Mr. Winslow mentions its occurrence near Cleveland. I met a flock of eight birds, in the spring of 1858, wading in a shallow pond in an old brickyard within the city (Columbus) limits, but was not so fortunate as to secure specimens. In the spring of 1861 a fine specimen was taken below the State dam, near the city, by a sportsman and taxidermist, which was preserved until recently." There appear to have been but two specimens actually captured in the state. We should make a better record than this for Ohio.

98. (254.) *TOTANUS MELANOLEUCUS* (Gmel.). 215.
Greater Yellow-legs.

Synonyms: *Scolopax melanoleuca*, *Gambetta melanoleuca*, *Totanus vociferus*.

Greater Tell-tale, Greater Yellow-shanks, Long-legged. Tattler, Stone-snipe.

Kirtland, Ohio Geol. Surv., 1838, 165.

Fairly common during the migrations over the entire state. It may be absent from some restricted localities where there are no ponds or wet meadows to furnish feeding places. Both Yellow-legs feed standing "knee" deep in the water, often immersing the entire head, but oftener darting about and thrusting here and there for some fleeing insect or tadpole. While they are not distinctly beneficial they are certainly not harmful to agricultural interests. They may often be seen in small flocks of about a dozen or less individuals, or singly on the borders of ponds of almost any extent, or on the lake shore.

This species reaches Oberlin about April 20th, and often tarries well into May. It returns again about the middle of September and remains a month. Rev. W. F. Henninger has a record for March 14, 1899, which is certainly early for the species, for southern Ohio.

99. (255.) *TOTANUS FLAVIPES* (Gmel.). 216.
Yellow-legs.

Synonyms: *Scolopax flavipes*, *Gambetta flavipes*.

Lesser Tell-tale, Common Yellow-legs, Lesser Yellow-shanks.
Kirtland, Ohio Geol. Surv., 1838, 161.

Judging from my own experience, this is the commoner form of this genus in northern Ohio at least. It is found in the same situations as the larger species, and frequently associates with it, while feeding, but seems to prefer to fly only with its own kind. I have seen companies of fifteen to twenty birds, in the ratio of two of the Greater to three of the Lesser Yellow-legs, feeding together, in starting up from the pool immediately separate, each species flying by itself.

Rev. W. F. Henninger has a record for southern Ohio on March 18, 1901. This is undoubtedly the earliest record for the appearance of this species for the state. The average date of arrival at Oberlin falls close to the first of May. This may be too late, since there are records for the middle of April. The southward movement begins early in August and continues to the end of September.

100. (256.) *HELODROMAS SOLITARIUS* (Wils.). 217.
Solitary Sandpiper.

Synonyms: *Totanus solitarius*, *T. chlorypigi*us. *Rhyacophilus solitarius*, *Tringa solitaria*.

American Green Sandpiper, Solitary Tattler, Wagtail, Tip-up.
Kirtland, Ohio Geol. Surv., 1838, 165.

As its name implies, this bird is solitary in its habits, and does not occur in flocks. It clearly prefers a small pond in the borders of some open woods, or in the midst of a pasture in which there remain scattering trees. It may also be

found in more open situations during the migration period, rarely loosely associated with Yellow-legs. I have never seen it in merely damp places, but it sometimes frequents small temporary streams which run through meadows. There seems good evidence that this sandpiper breeds sparingly from the vicinity of Columbus northward. I have seen individuals in each summer month. Dr. Wheaton found a young bird in the care of its parents near Columbus. The ease with which this species may be confounded with the Spotted Sandpiper may account for its apparent absence during the summer. It has the general appearance, and a note which closely resembles that of the Spotted Sandpiper, but lacks the round spots on the underparts, and has white spots on its back. The white spotted back should positively separate it from the Spotted Sandpiper, and its note should be equally distinctive from the Yellow-legs which also has white dorsal spots.

This sandpiper reaches Oberlin during the third week of April, and returns south rather late in October.

101. (258.) *SYMPHEMIA SEMIPALMATA* (Gmel.). 218.
Willet.

Synonyms: *Totanus semipalmatus*, *Scolopax semipalmata*.
Semipalmated Tattler.

Kirtland, Ohio Geol, Surv., 1838, 165.

Besides Dr. Wheaton's records, Dr. Langdon and Mr. Dury are the only ones who report this species. It has not been taken in Lorain county. Dr. Wheaton's statement, clearly based upon Dr. Kirtland's information, that it is "Not a common spring and fall migrant, probably breeds in northern Ohio," indicates that since 1838, when Dr. Kirtland found it in summer on the lake shore, it has become not only rare but almost extinct. If it still occurs near Cincinnati it is very rarely. Observers should watch carefully for the birds and report any occurrences.

102. (261.) *BARTRAMIA LONGICAUDA* (Bechst.). 220.
Bartramian Sandpiper.

Synonyms: *Actiturus bartramius*, *Totanus bartramius*, *Tringa bartramia*, *Tringa longicauda*.

Upland Plover, Bartram's Tattler, Field Plover, Grass Plover, Prairie Pigeon, Prairie Snipe.

Audubon, Orn. Biog., IV, 1838, 24.

This large upland sandpiper is fairly common during the entire summer over the greater part of the state, being rather less common along our southern border as a summer resident. While a few breed in the vicinity of Oberlin each year, the individuals are so few that they might easily be counted and their breeding places located. These birds are rather gleaners than probers, and therefore feed upon the insect life at the surface of the ground and among the grass, doing good service in meadows.

The average appearance for Oberlin is April 15, and the average date of last seen October 15. Rev. W. F. Henninger has a record for March 21, 1902, for southern Ohio. The birds leave the state about October 25.

103. (262.) *TRYNGITES SUBRUFICOLLIS* (Vieill.). 221.
Buff-breasted Sandpiper.

Synonyms: *Tryngites rufescens*, *Tringa subruficollis*, *T. rufescens*.

Kirtland, Ohio Geol. Surv., 1838, 165.

"Rare migrant, only noted in the fall. In addition to its occurrence noted by Dr. Kirtland (Cleveland, two specimens captured in August, 1840), it has since been taken on several occasions near Cleveland. A specimen was taken in the immediate vicinity of this city, August 31, 1876, which is now in the collection of the Ohio State University. This bird was in company with Semipalmated Plover and Semipalmated Sandpipers, on a gravelly bank of the Scioto river." (Wheaton, 1882.) Nothing more has been reported concerning this species.

104. (263.) *ACTITIS MACULARIA* (Linn.). 222.
Spotted Sandpiper.

Synonyms: *Tringoides macularius*, *Totanus macularius*, *Tringa macularia*.

Sandpiper, Spotted Tattler, Peet-weet, Wag-tail, Tip-up, Teeter-tail, Sand-lark.

Kirtland, Ohio Geol. Surv., 1838, 165.

This is the common little sandpiper throughout the state. No one who has walked by a lake shore or along the margins of any considerable stream or moderate to large pond, can have failed to see this bird. It is common everywhere all summer, breeding in fields or on the steep banks of lakes and rivers. Only once have I failed to find it on the lake shore in summer, gleaning among the debris thrown up by the waves. I have also watched it gleaning in the meadows and plowed fields.

The first reach Oberlin about April 17th, and the last are seen during the first week of September. These dates do not vary materially from those for southern Ohio contributed by Rev. Mr. Henninger.

105. (264.) *NUMENIUS LONGIROSTRIS* Wils. 223.
Long-billed Curlew.

Synonyms: Sickle-bill.

Kirtland, Ohio Ohio Geol. Surv., 1838, 165, 185.

The reports indicate that this rather conspicuous bird is rarely seen within the state, but the places of occurrence are so well scattered that it may be expected to occur occasionally over practically the whole of the state except the southeastern fifth. Dr. Wheaton records specimens taken near Cleveland by Dr. Kirtland; at Licking reservoir, specimens captured there having been examined by Dr. Wheaton, and the probability of its occurrence at St. Mary's reservoir; and Dr. Langdon's records of several specimens taken near Cincinnati. To these may be added Defiance (Slocum), Erie (Moseley), and an additional record of a flock of seven at Licking reservoir, May 31, 1902, recorded by the writer and Mr. Irving A. Field. While it is possible

that this species may be found breeding in some parts of the state, no positive record has yet been made to that effect.

It is likely that the birds arrive from the south about the middle of April, tarrying well toward June as the records prove. They might be mistaken for the Bartramian Sandpiper when so far away that the extremely long curved bill cannot be seen, but otherwise they should be easy of identification.

106. (265.) *NUMENIUS HUDSONICUS* Lath. 224.

Hudsonian Curlew.

Synonyms: Jack Curlew, Short-billed Curlew, American Wimbrel.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

Dr. Wheaton gives practically the same records for this curlew as for the Long-billed. Records from Defiance (Slocum), Erie (Moseley), and Ashtabula (Sim) have come to me. This species was regarded as less likely to occur than the preceding, by Dr. Wheaton. So far as the reports received are concerned it would appear to be scattered over the state about the same. It is strictly a migrant in the state. Dr. Wheaton had never seen it in Ohio.

107. (266.) *NUMENIUS BOREALIS* (Forst.). 225.

Eskimo Curlew.

Synonyms: *Scolopax borealis*.

Esquimaux Curlew, Dough-bird.

Wheaton, Ohio Agri. Report, 1860, 380, 480.

Dr. Wheaton's statement that it is a "Not common spring and fall migrant" seems to be pretty largely based upon a report from Mr. R. K. Winslow that "it is not rare in the vicinity of Cleveland," without specimens to prove the statement. Dr. Wheaton records only the capture of a specimen taken near Cincinnati by Mr. Shorten, in September, 1878, but states that he saw a single bird in a flock of Golden Plovers in the vicinity of Columbus. Prof. E. L. Moseley reports it as rare in Erie county as seen by Dr. Graffe. The similarity of this and the last species makes

any records other than those of actual captures of questionable value. Fortunately we have a specimen taken within the state.

Family CHARADRIIDÆ. Plovers.

The Plovers have short beaks which are not fitted for probing in the mud, but for gleaning from the surface. They wade some, but seem to prefer to keep near the edge of the water. They have a strong tendency to flock, but may also be found singly, even during the migrations.

108. (270.) *SQUATAROLA SQUATAROLA* (Linn.). 195.
Black-bellied Plover.

Synonyms: *Squatarola helvetica*, *Charadrius helveticus*, *C. squatarola*, *Tringa squatarola*, *T. helvetica*.
Swiss Plover, Bull-head Plover, Whistling Field Plover, Ox-eye, Beetle-head.

Kirtland, Ohio Geol. Surv., 1838, 165, 185.

This plover appears to be rare throughout the state. It has not been generally reported, but such reports as have been made indicate that it may be found occasionally everywhere except in the south-eastern fifth. Its migrations begin about the middle of April and may continue well toward June. In the autumn they should be found in August and September.

109. (272.) *CHARADRIUS DOMINICUS* Müll. 196.
American Golden Plover.

Synonyms: *Charadrius fulvus* var. *virginicus*, *C. pluvialis*, *C. virginicus*, *C. fulvus*.
Golden Plover, Field Plover, Bull-head Plover, Bull-head, Green-back, Green Plover.

Kirtland, Ohio Geol. Surv., 1838, 165, 184.

From common or even abundant during the spring migrations up to the time Dr. Wheaton's work closed, this plover has become hardly more than casual in most sections of the state. It is still found in some numbers occasionally, in spring, in regions where the small lakes are numerous, and

sometimes on the shore of Lake Erie. Several reports to the contrary notwithstanding, it does not nest in the state. Late spring and early autumn records of many of this group of birds do not necessarily indicate that they breed in the region where such records have been made. The "Shore Birds" linger late and return early.

The Golden Plover, as well as several other species, migrates in flocks which fly as one bird. When one individual has been shot from a flock the rest return for the lost one, and may be in danger of a similar fate at the hands of a thoughtless hunter. They should be looked for about the middle of April, and again in late August or early September.

110. (273.) *Oxyechus vociferus* (Linn.). 197.
Killdeer.

Synonyms: *Charadrius vociferus*. *Ægialitis vocifera*
Killdeer Plover, Ring Plover.

Kirtland, Ohio Geol. Surv., 1838, 165.

Of all members of this group of birds the Killdeer is probably the best known, because he talks about himself so much! He is among the first birds to come from the south in early March, not seldom reaching the lake shore with the Robin and Bluebird, but more often about a week behind them. One would expect a bird of his tastes to fare poorly while snow still covers the ground for days at a time, but he seems to find enough to keep him warm and active. At first he stays close to some low, wet place, gleaning from the surface of the mud, or searches out the fields which have been well kept and therefore furnish him with a clear surface to feed upon. It seems likely that the Killdeer sometimes eats soft seeds when insects, worms, and other soft animals are difficult to find, but I have no direct evidence of it. At any rate, he must be classed with the distinctly beneficial birds because of the insect larvæ which he eats.

The first decidedly spring thaw, which may occur late in February or not till the second week in March, brings this bird to Lorain county. He stays all winter in the southern

part of the state. His stay in the autumn is determined by weather conditions, but he is usually to be found until the first of November, and sometimes well toward the close of that month.

111. (274.) *ÆGIALITIS SEMIPALMATA* Bonap. 198.
Semipalmated Plover.

Synonyms: *Charadrius semipalmatus*.

Ring-neck, Ring Plover, Semipalmated Ring Plover.

Kirtland, Ohio Geol. Surv., 1838, 168, 184.

This little plover is far more common in autumn than in spring, and Dr. Wheaton records it but once in spring at Columbus—May, 1880. It is not uncommon at the lake shore in autumn, from the last week in July until the middle of September. It often associates with Killdeer and the Sanderlings, but in flight flocks separately. It is generally seen in small flocks, but single individuals are sometimes found on the lake shore as well as on the smaller ponds. Its single black breast band easily distinguishes it from Killdeer if its smaller size does not. I have never seen it feeding except at the water's edge or among the recently thrown-up wash on the shore. Its food seems to be largely insects and small mollusks.

112. (277.) *ÆGIALITIS MELODA* (Ord). 199.
Piping Plover.

Synonyms: *Charadrius melodus*, *Ægialitis melodus*.

Ring-neck.

Kirtland, Am. Journal Sci. and Arts, XL, 1841, 24.

It seems more than likely that the A. O. U. committee will finally reduce this and the next form to one species, but in the absence of legislation it seems necessary to include both forms. The interrupted black breast band of this form and the continuous breast band of the subspecies, a difference upon which the subdivision of the species was largely based, does not seem to be a good character.

Reports of the occurrence of this small plover are meager. Dr. Langdon and Mr. Dury report it from Cincinnati, Prof.

Moseley from Sandusky, there are specimens taken in Lorraine county, and the record of Dr. Wheaton for the vicinity of Columbus exhaust the records. It is certainly a rare migrant across the state, probably in late April.

113. (277a.) *ÆGIALITIS MELODA CIRCUMCINCTA* Ridgw.

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Belted Piping Plover.

Dr. Wheaton said of this form, in his 1882 catalogue, "Mr. Ridgway describes as a geographical race of this species, var. *circumcinctus*, from the Missouri region. To this variety Mr. Nelson refers the birds taken in Illinois by him, and doubtless Ohio birds are the same. But specimens of *circumcinctus* have been taken in various localities on the Atlantic coast and doubtless, as held by Mr. Brewster, the variety is untenable."

There are specimens of both forms in Ohio collections, but *circumcincta* appears to be the more numerous. Just as we go to press, Mr. W. L. Dawson, Prof. J. S. Hine and the writer have found some half-dozen pairs of this form breeding on the beach of Cedar Point, across from Sandusky, near the new Lake Laboratory of the Ohio State University. A set of four eggs was taken there, in an advanced state of incubation, June 26. This form should be found breeding in any suitable localities over the state.

Family APHRIZIDÆ. Turnstone.

The species which is found in Ohio always occurs in flocks while it is with us. I have never seen it except on the lake shore, where it was gleaning among the rubbish thrown up by the waves. It is a striking looking bird, easily identified.

114. (283.) *ARENARIA INTERPRES* (Linn.). 194.

Turnstone.

Synonyms: *Strepsilas interpres*, *Tringa interpres*.

Brant Bird, Calico-black, Bead Bird, Horse-foot Snipe.

Kirtland, Ohio Geol. Surv., 1838, 165, 184.

The Turnstone appears to be little known in the interior of the state. It has been recorded at Cincinnati (Langdon), but not elsewhere away from the lake shore. It is also reported from Erie and Cuyahoga counties. It is somewhat irregular in Lorain county, but generally seen during the spring migrations in small flocks. All of my records fall between May 16 and 20. I have not seen it in autumn. While here it remains near the water's edge, gleaning from the wash of the waves. I have rarely seen it feeding on the loose sand among the larger stones a rod or more from the water. Dr. Wheaton did not find it near Columbus.

ORDER GALLINÆ. Gallinaceous Birds.

To this group belong the Game Birds par excellence. Their flesh is pleasant because they feed so largely upon vegetable matter of various kinds. Careful investigation of the food of these birds reveals the fact that the proportion of cultivated grain eaten is very small, while the weed seeds form a large proportion. There can be no doubt that of the grain eaten much is what has fallen during harvest, and so would be wasted if the birds did not get it. In some localities members of this group do eat grain to a considerable extent, but the habit is not general by any means. In winter buds and tender shoots of trees are eaten, and in summer insects are freely destroyed. There is always great danger that the birds comprising this group will suffer extinction because they are killed both for sport and for their flesh. Legislation limiting their destruction needs to be specific and not disregarded by citizens.

Family TETRAONIDÆ GROUSE, etc.

115. (289.) *COLINUS VIRGINIANUS* (Linn.). 184.

Bob-white.

Synonyms: *Ortyx virginianus*, *Perdix virginiana*, *Tetrao virginianus*.

Virginia Partridge, "Quail," Partridge.

Wilson, *Am. Orn.*, VI, 1812, 21.

Bob-white is still common in all portions of the state, but

is evidently less numerous than a score of years ago. It is reported as abundant from a few localities. The prohibitive laws have prevented any great diminution in numbers. It seems likely that the modern restrictions thrown around the sportsmen will tend to diminish their numbers or at least dampen their ardor for the chase, thereby increasing the chances of life for the "Quail." It would be a distinct æsthetic loss if the Bob-white should wholly disappear from our fields and woods. Literature is too full of references to his prophetic warning or encouragement for us to consent to his extinction.

I find no evidence that Bob-white migrates to any appreciable extent. It is probably hardly proof that he does not because a flock or covey is known to occupy the same region the year through, but it looks in that direction. Unfortunately we have almost no means of knowing for a certainty the individual birds, and so are unable to follow them all the year. It seems likely that there is some small southward movement during the colder weather, or with the appearance of considerable snow.

Dr. Sylvester D. Judd has proved that Bob-white eats very little grain, and that little is probably largely waste grain, but he does consume great quantities of weed seeds, particularly those of the ragweed. Farmers can coax a flock of Bob-whites to their barn-yards by throwing grain out to the flock, but it would be a pity to do so for the purpose of killing them.

116. (300.) *BONASA UMBELLUS* (Linn.). 182.

Ruffed Grouse.

Synonyms: *Tetrao umbellus*.

Partridge, Pheasant.

Kirtland, Preliminary Report, Ohio Geol. Surv., 1838, 67.

This strictly woods game bird has rapidly decreased in numbers in the last decade; partly because it has been so persistently hunted and partly because its breeding haunts have been destroyed in so many places. It is reported as still fairly common in the north-eastern third of the state,

and locally elsewhere, but it is rare in most other localities. None have been seen in Lorain county west of Elyria for three years. Ten years ago it was frequently met in the woods about Oberlin. It is resident where it occurs at all, remaining in the deep woods. Its drum call is familiar to every countryman.

Family PHASIANIDÆ, TURKEYS.

117. (310a.) MELEAGRIS GALLOPAVO SYLVESTRIS (Vieill.).
181.

Wild Turkey.

Synonyms: *Meleagris gallopavo* var. *americana*, *M. gallopavo*,
M. g. var. *gallopavo*, *M. fera*, *M. gallopavo fera*.

Common Wild Turkey, Eastern Wild Turkey.

Bonaparte, *Am. Orn.*, I, 1825, 80.

This, the noblest of the game birds, is all but extinct within the state. It should not be placed upon the list of extinct species until the southern counties between the Scioto river and Cincinnati have been more thoroughly worked. It may be present there still.

ORDER COLUMBÆ. Pigeons.

Of the two members of this order found in Ohio only one is now numerous enough to receive attention as regards its food. That has been done under the discussion of the species. It is noteworthy that in the eastern parts of the United States the Mourning Dove builds its nests well above the ground, almost always, but in the west on the ground, and in the middle west indifferently on the ground or above it. Of course there are exceptions in each region.

118. (315.) ECTOPISTES MIGRATORIUS (Linn.). 179.
Passenger Pigeon.

Synonyms: *Ectopistes macrura*, *Columba migratoria*.
Wild Pigeon.

Wilson, *Am. Orn.*, I, 1808, 102.

This once extremely abundant species is now of casual

occurrence during the migrations. It is likely that scattering records of single individuals or very small companies may be made from time to time. Many localities on the Western Reserve have their histories of great flights and immense rookeries. Before they have entirely passed from the memory of those who knew of them personally these places should be mapped for future reference.

119. (316.) *ZENAIIDURA MACROURA* (Linn.). 180.

Mourning Dove.

Synonyms: *Zenaidura carolinensis*, *Columba carolinensis*, *C. macroura*.

Carolina Dove, Turtle Dove, Wild Dove.

Kirtland, Ohio Geol. Surv., 1838, 164.

The Mourning Dove ranks well up among the familiar birds, because it frequently nests in the orchard or shrubbery in towns and the suburbs of cities. It is a familiar bird along country roads in summer, taking dust-baths or gleaning for food. A few hardy individuals remain even in the extreme northern parts of the state all winter, but many pass the winter in the southern parts of the state. The bulk of the migrations occur about the middle of April in Lorain county. It is impossible to tell when the most go south, because they are so quiet about it. Few are seen during the molting period, which begins after the last brood is raised, and nests with eggs are found even during the first week in September.

Observations upon the food of the doves and examinations of their stomachs prove that while in spring and summer a good deal of wheat is eaten, by far the largest proportion of the dove's food consists of the seeds of noxious weeds. Undoubtedly the most of the wheat eaten is what the birds find among the stubble after the crop has been harvested. I have many times flushed doves from cornfields, during July and August, and found that they were eating the partly ripe seeds of the grasses which are the plague of the farmer's life. The Mourning Dove seldom occurs in flocks of any size, and therefore any depredations upon grain fields will hardly be noticed.

ORDER RAPTORES. Birds of Prey.

SUBORDER SARCORHAMPHI. American Vultures.

Family CATHARTIDÆ. American Vultures.

120. (325.) CATHARTES AURA (Linn.). 177
Turkey Vulture.

Synonyms: Vultur aura, Rhinogryphus aura.
Turkey Buzzard.

Wilson, Am. Orn., IV, 1812, 89.

The Turkey Vulture is fairly common during the summer throughout the state, even to the lake shore, the books upon birds to the contrary notwithstanding. During my residence at Oberlin, beginning in 1890, it has been almost common, nesting in fallen hollow logs or hollow stumps. It remains all winter in the southern parts of the state, but is absent in winter north. I have found it as early as the 7th of March at Oberlin.

Its habit of feeding on carrion is well known.

If the birds are too far away for one to see the bare head, the soaring flight without any flapping of the wings, or only an occasional stroke to regain balance, readily identifies the species. The hawks soar, it is true, but they also flap their wings a good deal, or soar in circles, while the vulture soars almost straightaway, without wing strokes.

121. (326.) CATHARISTA URUBU (Vieill.). 178.
Black Vulture.

Synonyms: Carthates atratus, C. iota, Catharista atrata, Vultur atratus.

Carrion Crow.

Audubon, Orn. Biog., II, 1834, 33.

The foregoing reference by Audubon that this species summers in Ohio as far as Cincinnati; three specimens seen by Dr. Langdon, "On or about December 20, 1876," one of which he secured on January 1, 1877, it having been killed a few days previous by Mr. Edwin Leonard, of Madisonville; and a specimen in Mr. Oliver Davie's collection, killed

February 6, 1895, four miles north of Reynoldsburg, seem to constitute the Ohio records for this southern species.

SUBORDER FALCONES. Kites, Hawks, Eagles, Falcons,
Osprey.

Family FALCONIDÆ. Same as above.

The food habits are fully given under each species.

122. (327.) ELANOIDES FORFICATUS (Linn.). 166.
Swallow-tailed Kite.

Synonyms: *Falco furcatus*, *Nauclerus furcatus*, *Falco forficatus*.
Wilson, Am. Orn., VI, 1812, 70.

Writing in 1812, Wilson said that this Kite "is very abundant in South Carolina and Georgia, and still more so in West Florida, and the extensive prairies of Ohio and the Indiana Territory." Dr. Kirtland found it "in considerable numbers in Portage and Stark counties" in the middle thirties, but noted its absence in 1838. Mr. Kirkpatrick found it occasionally in Crawford county, where it had been numerous before, in 1858. This was the last seen of this elegant bird until a specimen came into Dr. Wheaton's hands from Pataskala, where it was killed August 22, 1878. Twenty years later in August, 1898, Rev. W. F. Henninger notes a specimen shot in Ross county near Chillicothe. This seems to close the records to date.

123. (331.) CIRCUS HUDSONIUS (Linn.). 167.
Marsh Hawk.

Synonyms: *Circus cyaneus* var. *hudsonius*, *Falco cyaneus*, F.
hudsonius.

Marsh Harrier, Harrier, Mouse Hawk, Blue Hawk, American
Marsh Hawk.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

In habits this hawk is unlike any of the other hawks. It lives in the open country, nesting and perching on the ground. It may always be known by its white rump spot or patch, and by its relatively small body and long, pointed

wings and long tail. It flies more like a swallow than a hawk, as it skims over the meadows or sweeps upward and away with graceful, easy strokes. It is hardly common generally over the state, but is found in considerable numbers in especially favorable places.

The food of this hawk proves it to be one of the most beneficial of all our predaceous birds. It does sometimes eat poultry and small birds, but the proportion of these to the whole food of mice, snakes, insects, and squirrels is so small that it should not count against him. While their young were still in the nest I have seen the male return from a search over the meadows with a good-sized snake, apparently not yet dead, in his talons, and drop it from a considerable height to the female who would always catch it before it reached the ground.

The Marsh Hawk is not a common winter resident, even in the southern counties, and breeds but rarely if at all there. It passes north early in March, reaching the lake shore before the first of April, sometimes as early as the last week in February. It has not been found in Lorain county after the middle of October.

124. (332.) *ACCIPITER VELOX* (Wils.). 169.

Sharp-shinned Hawk.

Synonyms: *Accipiter fuscus*, *Falco velox*, *Falco fuscus*, *Nisus fuscus*.

"Pigeon Hawk."

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

This little hawk is hardly common anywhere in the state, but it is everywhere present all the year. While it prefers the woods, skulking through the smaller growth low down if it has been feeding, it may often be seen flying across the open. In flight it may be known from the Sparrow Hawk by its larger size, long barred tail, lack of reddish in the feathers of the back, and by the fact that it does not hover over the meadows but skulks in the woods.

It lives principally upon small birds and young poultry and English Sparrows, only occasionally killing mice and

other small mammals. It is distinctly injurious, but is becoming less so in winter because it now prefers English Sparrows to other birds. It is therefore becoming more numerous in the cities and towns and less so in the country. If he will only grow fonder of the sparrow pests and leave the young poultry alone we can easily forgive the past and give him encouragement for the future.

125. (333.) ACCIPITER COOPERII (Bonap.). 168.
Cooper Hawk.

Synonyms: *Falco cooperi*, *Astur cooperi*, *Nisus cooperi*.

Chicken Hawk, Big Blue Hawk, Big Blue-tailed Hawk, Long-tailed Dart, Darter.

Kirtland, Ohio Geol. Surv., 1838, 164, 179.

This medium-sized hawk is more often found in the woods than elsewhere. Indeed, it is seldom seen out of the woods except while it is soaring up almost out of sight, or while it is making a raid upon the poultry yard. It differs from the Sharp-shinned Hawk in having a long, rounded tail and rounded instead of rather pointed wings. To one who knows these two birds there is no difficulty in identifying them, but the difference is hard to explain. In general, the Sharp-shinned gives the impression of sharp angles with its pointed wings and square cut tail, while the Cooper has a decidedly rounded outline for both wings and tail. The Cooper is a larger bird. Its metallic "tic, tic, tic, tic," is its characteristic call, usually uttered during the breeding season.

This hawk is a common resident in the southern parts of the state, but is rare in winter north of Columbus. The individuals which migrate reach Oberlin about the middle of April, and depart late in October.

Like the Sharp-shinned, this hawk lives principally upon small birds, poultry also composing a large share of its food. It occasionally eats snakes and small mammals, but distinctly prefers the hot-blooded birds. If it eats English Sparrows their numbers must be small, because it does not come into the cities and towns for them. The maledictions heaped

upon him are his death knell. We can only hope that he will not take down with him the many hawks which are distinctly beneficial, thus depriving us of Nature's balancers for the injurious rodents and larger insects.

126. (334.) ACCIPITER ATRICAPILLUS (Wils.). 170.

American Goshawk.

Synonyms: *Astur atricapillus*, *Falco palumbarius*, A. p. var. *atricapillus*.

Goshawk, Blue Hen Hawk, Chicken Hawk.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

The Goshawk is so much like the Cooper Hawk that it is not known by more than a few of the more experienced Ohio ornithologists. It is larger, with a relatively shorter tail, and the general color is bluish-slate, so much so that the bird is often called the "Blue Hawk." It is much more northern in its distribution, reaching Ohio only in winter, and then occurring over the entire state in small numbers. It seems likely that some of the northern winter records for the Cooper Hawk may really be for this species. The records of its occurrence in the state are too few to make any statement of the time when it may be expected to reach the state from the north reliable. It seems likely that it arrives with the first cold and snow.

In food habits this species resembles the Sharp-shinned and Cooper Hawks, but its larger size necessitates larger quarry. It lives principally upon birds, the grouse forms contributing the most to its bill of fare. It can easily make off with an ordinary sized chicken, which it is very willing to come into the barn-yard for. It is so bold a hunter that the presence of man seems to make no difference whatever. Many instances have been recorded when it has picked up a chicken from the ground at the feet of persons who were feeding the flock. The Ptarmigan and Ruffed Grouse are favorite tidbits in its summer home. In summing up the evidence Dr. Fisher says: "Little can be said in favor of this Hawk, as the destruction of a few injurious rodents is a very meager offset for the great number of game birds

and poultry it destroys." Fortunately it is not numerous enough in our state to inflict any appreciable damage.

127. (337.) *BUTEO BOREALIS* (Gmel.). 171.

Red-tailed Hawk.

Synonyms: *Buteo aquilinus*, *Falco borealis*, *F. aquilinus*.

Red-tailed Buzzard, Hen Hawk.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

This large hawk appears to be migratory to some extent, passing farther south in winter when the ground is covered with snow. However, it is a fairly common resident over the entire state. It is sometimes absent from the northern counties for two or three weeks during the period of snow covered ground, usually in the early part of February. It has the undeserved title of "Hen Hawk," which should be transferred to the Goshawk. While it is true that this large hawk sometimes feeds upon poultry in some regions more than in others, it clearly prefers other quarry. Dr. Fisher says, "Abundant proof is at hand to show that this Hawk greatly prefers the smaller mammals, reptiles and batrachians, taking little else when these are obtainable in sufficient numbers; but if hard pressed by hunger it will eat almost any form of animal life, such as poultry and other birds, insects, crawfish, or even offal or carrion. . . . It is to be remarked that young Hawks are less particular as to the character of their food, and they are more frequently found to be the depredators of the poultry yards." Rev. Mr. Henninger has found that in southern Ohio, at least in Pike and Scioto counties, the Red-tails feed almost exclusively upon birds and poultry.

With the evidence all in we must say that while this large hawk is sometimes a menace to the poultry yard and at such times must be killed, it is generally far more beneficial than injurious, and therefore should not be persecuted unto death whenever found.

This hawk may be seen soaring in ascending spirals almost anywhere in any region of the state on fair days. It nests in the woods, but apparently feeds as much in the open

fields as in the woods. It may be easily distinguished from the other large hawks by the bright rufous of its tail, which may have a band of dusky near the tip.

128. (339.) *BUTEO LINEATUS* (Gmel.). 172.

Red-shouldered Hawk.

Synonyms: *Falco hyemalis*, *F. lineatus*, *F. buteodes*.

Red-shouldered Buzzard, Winter Hawk, Chicken Hawk.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

In northern Ohio this hawk is the most numerous large hawk, the little Sparrow Hawk alone outnumbering it. It is less common during the winter than during the summer, and may be absent for three or four weeks in the latter part of January and February when the cold is severest. It seems to be much less common, if present at all, in the southern part of the state in summer. I did not see it along the Ohio river in August. It may be known from the other large hawks by the lack of any rufous on the tail and by the moderate length of its tail. Its cry is *pil ye, pil ye*, differing from the cry of the Red-tail, which is a continuous scream.

There seems to be no evidence that this hawk eats poultry. Dr. Fisher states that it eats mammals, birds, snakes, frogs, fish, insects, centipeds, spiders, crawfish, earthworms, and snails. Its food is therefore more varied than that of any other member of this order. It is distinctly beneficial, and if injurious at all so very little so that it may not be counted as cause for the death sentence except on the rarest of occasions.

The general habits of this hawk resemble those of the Red-tail, but its nest is not placed so high, usually, and it is not quite so wary.

129. (343.) *BUTEO PLATYPTERUS* (Vieill.). 173.

Broad-winged Hawk.

Synonyms: *Buteo pennsylvanicus*, *Falco pennsylvanicus*, *F. latissimus*, *B. latissimus*.

Broad-winged Buzzard.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

This is another little known hawk, not because it is rare, for it is present in some numbers throughout the state, but because it apparently differs but little from several other middle-sized hawks. It is about the size of the Cooper Hawk, but differs from that species in having a much shorter tail and in having the wings more slender and therefore more pointed instead of rounded. It differs from the Sharp-shinned in being larger and in its habit of soaring like the other hawks of the genus *Buteo*. Perhaps the most reliable character is its unsuspiciousness of man. It will permit a near approach without manifesting either uneasiness or curiosity.

Dr. Fisher says: "The food of this hawk consists principally of insects, small mammals, reptiles, and batrachians, and occasionally of young or disabled birds. A specimen secured by the writer just after a shower was gorged with earthworms. In spring when toads frequent ponds to spawn, it devours large numbers of them, and later in the season it is a not uncommon occurrence to see an individual with a snake or frog dangling from its talons." Probably the greatest service which this hawk renders is in the destruction of large numbers of the large insect larvæ which most birds do not touch. While it eats some animals which are beneficial it is too useful a bird to be killed indiscriminately, but should be accorded protection.

This hawk should be found wintering in the state south of Columbus, but probably in small numbers. It reaches northern Ohio in the spring about the middle of March, and has gone south again by the middle of November.

130. (347a.) *ARCHIBUTEO LAGOPUS SANCTI-JOHANNIS*
(Gmel.). 174.

American Rough-legged Hawk.

Synonyms: *Falco sancti-johannis*, *Archibuteo sancti-johannis*,
A. lagopus.

Rough-legged Buzzard, Black Hawk.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

This large hawk occurs only during the winter, when it

ranges across the state. Being semi-nocturnal in habits it is not often seen by those who go out only during bright day, and so is regarded rare or absent from many regions where it undoubtedly occurs. I have found it in Lorain county only after the holidays, usually in late winter and early spring. In feeding habits it somewhat resembles the Marsh Hawk, beating low over the meadows and fields and pouncing upon the mice and moles from its low flight.

Dr. Fisher says: "Its food consists principally, if not almost exclusively, of the smaller rodents, and most prominent among them are the arvicoline mice and lemmings." It is therefore clear that this hawk should be welcomed to our fields and meadows and orchards where these pests abound.

Probably the chief character which will distinguish this large hawk from all the others in flight is its dark color. It is so much smaller than the eagles that the comparison would appeal to any one at once.

131. (349.) *AQUILA CHRYSÆTOS* (Linn.). 175.
Golden Eagle.

Synonyms: *Aquila chrysaetus* var. *canadensis*, *Falco fulvus*, *F. chrysaetus*, *Aquila canadensis*.

Ring-tailed Eagle.

Kirtland, Ohio Geol. Surv., 1858, 67, 177.

It is not at all likely that this eagle nests in the state. It seems to be a rare winter visitor, but is reported from all sections. Mr. Harry B. McConnell tells me that three have been captured in the vicinity of Cadiz within the past three years. I have four records for Lorain county within the last five years. One was shot, not far from Oberlin, in the act of carrying off a hen from a barn-yard.

"The food consists mainly of mammals and birds, of which spermophiles, rabbits, fawns, lambs, turkeys, water fowl and other large birds form the principal part, though offal and carrion are sometimes taken.

"To sum up, it may be stated that in sections of the country where rabbits, prairie dogs and gophers are abundant

the Golden Eagle is very beneficial, confining its attention mainly to those noxious animals; but in places where wild game is scarce it is often very destructive to the young of domesticated animals, and hence in such places has to be kept in check." (Fisher.)

There are many accounts of the ferocity and cruelty of this large bird of prey, some of which are probably true. It has been known to kill a good sized black-tailed deer, and in rare instances to attack a man who interfered with it while it was feeding. Even in defense of its young it is usually not courageous but an arrant coward. It is more than likely that the accounts of the capture of children by this bird are good illustrations of vivid imagination. While a hungry bird might pounce upon an unprotected infant it is extremely unlikely that a child old enough to walk would be molested.

132. (352.) *HALIÆTUS LEUCOCEPHALUS* (Linn.). 176.
Bald Eagle.

Synonyms: *Falco leucocephalus*, *F. washingtonianus*, *F. washingtonii*.

White-headed Eagle, Bird of Washington.

Wilson, *Am. Orn.*, IV, 1812, 890.

While the Bald Eagle is common near Sandusky and among the islands north of there, it is rare in the other parts of the state. It does not seem to migrate southward in winter, but is strictly resident wherever it occurs. The two eagles are too large to be confused with the hawks, and the white head and tail of this species is wholly distinctive.

"The favorite food of the Bald Eagle is fish, and where this vertebrate can be procured the bird will touch little else. Of the hundreds of these Eagles which the writer has watched, none were observed ever to touch anything except fish or offal picked up from rivers or along their shores. What proportion of the fish consumed is taken from the Osprey is hard to estimate, but the number must be very great.

"What we have said in reference to the Golden Eagle

applies equally well to the bird under consideration, namely, that over the greater part of the country where the natural food, fish in the present case, is abundant it is a harmless bird and should be protected; while in sections where it is injurious to sheep or other domesticated animals it should not be allowed to become numerous." (Fisher.)

There seem to be several well authenticated instances when this eagle has attacked human beings, for one cause or another, but it is equally true that it does not often do so. Indeed, the provocation would have to be great, for the birds are usually cowards in the presence of man.

It is well known that the Bald Eagle's regular practice is to wait until the Osprey has captured a fish when the eagle attacks him and forces him to drop it, whereupon the eagle secures it for himself. While it is hard on the Osprey it is easy for the eagle.

133. (356.) *FALCO PEREGRINUS ANATUM* (Bonap.). 162.
Duck Hawk.

Synonyms: *Falco communis* var. *anatum*, *Falco peregrinus nævius*, *F. peregrinus*, *F. anatum*, *F. communis*.

Peregrine Falcon, Great-footed Hawk, Wandering Falcon.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

The Duck Hawk seems to be the least known of our smaller hawks, yet it must be pretty well distributed over the state, at least in winter. It is one of the most fearless of our birds of prey, and a true Falcon in its swiftness of wing, quickness, and dash. It is able to overtake and kill a pigeon or teal in full flight. Nothing seems able to escape by its swiftness alone. It is also persistent to the last degree, following a flock of ducks or other birds for miles, often for days, killing whenever hungry. Hunters often complain that their kills have been seized by this hawk from under their hands.

Concerning the actual records for this hawk within the state there is little to say. Mr. Dury has taken several specimens at St. Mary's reservoir; Dr. Jasper took one at Columbus; there is a specimen in the collection of Mr.

A. Hengartner, of Lorain, taken near the lake shore; and a specimen was taken in one of the State University buildings during the winter of 1902-3. Mr. W. L. Dawson reports one positively identified, at Columbus, March 5, 1902. There are reports of other birds having been seen, but if there have been any captures they have not been reported. Dr. Wheaton supposed that it might be found nesting in the northwestern part of the state, but if it does it is unknown to me.

The large size for a Falcon and the boldness and swiftness of this hawk are about all the field characteristics that I can give. It could not be taken for one of the Buteo group, nor for anything but a Falcon. It is the largest of that group inhabiting Ohio.

"The food of this hawk consists almost exclusively of birds, of which water-fowl and shore birds form the greater part. In sections of the country where its nest is surrounded by cultivated lands, the bird is bitterly complained of by the farmers on account of its inroads on the poultry." (Fisher.)

134. (357.) *FALCO COLUMBARIUS* Linn. 163.

Pigeon Hawk.

Synonyms: *Æsalon columbarius*, *Hypotriorchis columbarius*,
Falco lithifalco var. *columbarius*.

Kirtland, Ohio Geol. Surv., 1838 161, 178.

This little Falcon appears to be rare in the state, as a migrant or winter resident everywhere except in the northern tier of counties where it has been found breeding rarely. There are generally several records each winter near Oberlin. During the migrations it may be found near or even traveling a little behind the flocks of blackbirds and other small flocking birds, preying upon them. It should be found during the winter in the southern parts of the state pretty regularly, but in small numbers.

"The food of the Pigeon Hawk consists mainly of small and medium sized birds, especially the gregarious species, insects, and occasionally small mammals. Pigeons, Flickers and Grackles are about as large birds as it usually attacks,

though Dr. Dall in one instance saw it kill a Ptarmigan, and Dr. E. A. Mearns speaks of a specimen shot in the act of destroying a hen. Among insects dragon flies are favorite morsels for this Hawk, and the apparent ease with which it captures these nimble winged insects demonstrates better than anything else its remarkable power of flight. The writer has also found grasshoppers, crickets and beetles among the stomach contents." (Fisher.)

It is not easy to distinguish between this and some others of the small hawks. However, this is one of the smallest and darkest, with the habits of a Falcon, snatching its prey from the ground or in the air without stopping its flight instead of pouncing upon it and bearing it down by its weight.

135. (360.) FALCO SPARVERIUS Linn. 164.

" American Sparrow Hawk.

Synonyms: Tinnunculus sparverius.

Sparrow Hawk, Rusty-crowned Falcon.

Kirtland, Ohio Geol. Surv., 1838, 161, 178.

This is universally conceded to be the commonest of our hawks. It is common everywhere during the summer, but is less common in the northern third of the state in winter than in summer. It frequently comes into towns and city parks at almost any time, to catch English Sparrows, and is therefore seen by many persons who know nothing about any other hawks. It is readily distinguished from all other hawks by its bright rufous back and tail, and in the field by its habit of hovering over a meadow as it scans the ground for a mouse or insect. I have seen one spend an hour looking over a ten-acre field in this way, hovering in one place for about a minute, then change its position and hover again, and finally fly to another field when unsuccessful.

"The Sparrow Hawk is almost exclusively insectivorous except when insect food is difficult to obtain. In localities where grasshoppers and crickets are abundant these hawks congregate, often in moderate sized flocks, and gorge themselves continuously. Rarely do they touch any other kind

of food until, either by the advancing season, or for other natural causes, the grasshopper crop is so lessened that they can no longer appease their hunger except by undue exertion. Then other kinds of insects and other forms of life contribute to their fare; and beetles, spiders, mice, shrews, small snakes, lizards or even small birds are required to bring up the balance." (Fisher.) It therefore seems certain that the farmer has no better friend than this little Falcon. He may rarely exact toll in the form of chicken meat, but that should no more count against the whole group of Sparrow Hawks than an occasional chicken stealing cat should count against all cats.

While this hawk nests in hollow trees in the woods, or more properly on the borders of woods preferably, it is more often seen in the open than in the woods, except when nesting. It feeds in the open then but stays near home.

136. (364.) *PANDION HALIAETUS CAROLINENSIS* (Gmel.).
165.

American Osprey.

Synonyms: *Pandion haliaetus*, *Falco haliaetus*, *Pandion carolinensis*, *Falco carolinensis*.

Fish Hawk, Osprey.

Kirtland, Ohio Geol. Surv., 1838, 161.

The Osprey is not common anywhere in the state, but it is likely to be present wherever fish are to be found near the surface of the water. It should breed at the large reservoirs and lakes, but there are no such reports from those regions. It is found all summer at the lake shore, but I am not aware that a nest has actually been found. Rev. Mr. Henninger states that it occurs in Scioto and Pike counties during the winter and during the spring and autumn migrations in some numbers, feeding along the Scioto river. It visits the Oberlin water-works reservoir pretty regularly the first or second week in May, often tarrying for several days in the vicinity because the fish are so numerous and so easy to catch.

The Osprey's food is exclusively fish, almost always cap-

tured alive, but rarely dead ones are picked up from the surface of the water if the bird is hard pressed for food. I have seen it catch fish so large that it was barely able to get out of the water with its catch. There are instances when the bird has struck so large a fish that, unable to loosen his hold, he has been drawn under the water and drowned. Large fish have been washed ashore with an Osprey still clinging to them in death, the claws set too firmly in flesh and scales to be loosened.

It has been stated that where Bald Eagles are found there the Osprey will be also. That has not proved true in the region of Sandusky where the eagles are more numerous than elsewhere in the state. Perhaps the Ospreys have learned to avoid that region.

SUBORDER STRIGES. Owls.

Family STRIGIDÆ. Barn Owls.

137. (365.) *STRIX PRATINCOLA* Bonap. 152.

American Barn Owl.

Synonyms: *Strix flammea* var. *americana*, *S. flammea*, *Aluco flammeus americanus*.

Barn Owl, Monkey-faced Owl.

Kirkpatrick, Ohio Farmer, VIII, 1859, 35.

"Rare visitor. Not over half a dozen individuals recorded." (Wheaton.) There has been a very manifest increase in the numbers of this owl since Dr. Wheaton wrote the above quotation. It is now almost common in the southern parts of the state, being even common locally. In the northern half of the state it is generally reported as rare. Numbers of specimens have been taken along the whole lake front. It is resident everywhere, and will usually be found in barns and church steeples or similar places where it spends the day, sallying forth at dusk for its daily catch of rats and mice.

The bird may be known at once by its "monkey face," lack of ear tufts, and bright reddish-brown color. It is

considerably larger than the Screech Owl, which may be reddish, but has ear tufts.

"All testimony goes to show that the Barn Owl is one of the most beneficial of rapacious birds. . . . Its food undoubtedly consists principally of several species of rodents which, from their great number and destructive habits, are a curse to the country they inhabit. . . . In the east its food consists largely of mice and rats which it destroys with as much energy as it does the gophers of the west. All the common species, including the meadow, house, and white-footed mice, as well as the common rat are eaten with equal relish" (Fisher). Mr. Charles Dury gives an account of a colony of these owls which lived in the town hall in Glendale, Ohio, in which he says, "But the strangest part of the curious habitation was the flock of domestic pigeons that were living seemingly on intimate terms with the owls, and, judging from the old pigeon nests, I presume the pigeons had actually nested and reared their young there. The floor where they lived was literally covered with the pellets which the birds had disgorged, after the manner of the owl tribe." It seems to be beyond question that one Barn Owl is worth a whole family of cats as a mouser, and that it is far less likely to steal a chicken than the average cat is.

Family BUBONIDÆ. Other Owls.

138. (366.) ASIO WILSONIANUS (Less.). 153.

American Long-eared Owl.

Synonyms: *Otus vulgaris* var. *wilsonianus*, *Asio americanus*,
Otus vulgaris, *O. wilsonianus*.

Long-eared Owl, Cat Owl.

Audubon, Orn. Biog., IV, 1838, 572.

One must look in the woods for this owl, where it nests and where it feeds by night and rests by day. It is not common anywhere in the state, but is pretty generally distributed. In Lorain county it has been found both singly and in companies of six individuals in winter, and its cry is sometimes heard during the summer while it is nesting. It

inhabits the stream gorges in which there is a considerable growth of evergreen trees, in winter, and may be closely approached there. While it is strictly nocturnal it can see well enough in bright sunlight to thread its way in rapid flight through the mazes of the trees. Its confidence in its protective colors and attitude often proves fatal.

This owl may be identified in the field as a medium-sized bird with conspicuous ear tufts. The only other owls with conspicuous ear tufts are either so much smaller or so much larger that one should have no difficulty in making the determination.

"The Long-eared Owl is one of our most beneficial species, destroying vast numbers of injurious rodents and seldom touching insectivorous birds. As this owl is readily destroyed, it is the one that suffers most when shortsighted legislators enact laws for the destruction of the birds of prey. It is both cruel and pernicious to molest a bird so valuable and innocent as the one under consideration." (Fisher.) Like other birds of prey, this owl will attack poultry or even small dogs when hard pressed for food. Insects may form a fair proportion of the summer diet of these birds where they are easier to obtain than rodents.

139. (367.) *ASIO ACCIPITRINUS* (Pall.). 154.
Short-eared Owl.

Synonyms: *Brachyotus palustris*, *Strix brachyotus*, *Brachyotus cassinii*, *Otus brachyotus*, *Strix accipitrinus*.

Marsh Owl, Prairie Owl.

Kirtland, Ohio Geol. Surv., 1838, 161, 179.

This owl is just as truly a bird of the open fields as the Long-eared is of the woods. It even nests on the ground, and roosts under overhanging banks in almost any ditch or considerable gorge. In Lorain county I have never seen more than two together, and they on the lake shore in winter. Several are seen each winter or early spring, but it must be regarded as uncommon if not rare. I have never seen it in summer. It appears to be common during the win-

ter in some parts of the southern counties, and likely nests in the more extensive prairies and swampy regions. It may be known by its habit of feeding during the early forenoon and late afternoon in broad day, and by its habit of feeding in the fields. While it has ear tufts they are too small to be seen unless the bird raises them in excitement.

"The food of this Owl consists largely of mice and other small mammals. A number of species of insects, birds, and reptiles also may be mentioned as occasionally contributing to its fare. Fully 75 per cent of the stomachs examined in the Department of Agriculture contained mice. . . . Of the other mammals which this Owl feeds upon may be mentioned shrews, gophers, and sometimes small rabbits." (Fisher.) The verdict is clearly for protection of this owl, even if he does sometimes kill useful animals.

140. (368.) *SYRNIUM VARIUM* (Barton). 155.
Barred Owl.

Synonyms: *Strix nebulosa*. *Syrnium nebulosum*.

Hoot Owl, American Wood Owl, Round-headed Owl.

Kirtland, Ohio Geol. Surv., 1838. 161.

This is the most common large owl, and stands next to the Screech Owl in numbers. It is strictly resident throughout the state, and as strictly arboreal. It is nocturnal, but sometimes feeds during dark days or at twilight. Its cry "*who cooks for you, who cooks for you, who!*" may be heard in almost any large woods during the early evening or early morning hours, while its blood-curdling caterwaulings are more often reserved for the small hours when the camper is sure to be asleep! In these later days some of the thrilling accounts of "encounters" with wild cats and panthers in the more settled districts of the state are traceable to the night calls of this owl. Certain it is that a sudden awakening in the wee hours with the unearthly squalls from this owl, perched just overhead, ringing in your ears, meets instant response from your hair!

"In summing up the facts relating to the food habits of this Owl it appears that, while the general statements of

certain authors, especially the earlier ones, charge the bird with destruction to poultry, game, and small birds, such destructive habits are comparatively uncommon. That it does occasionally make inroads upon poultry yards, and does more or less damage among game birds, is true; but the systematic collection and examination of a large number of stomachs show the exceptional character of such acts and reveal the fact that the larger part of the food consists of mammals. And it is to be noted that among the list are some of the most destructive rodents the farmer has to contend with. If a fair balance is to be struck, therefore, it must be considered that this Owl is on the whole beneficial, and hence should occupy a place on the list of birds to be protected." (Fisher.)

141. (370.) SCOTIAPTEX NEBULOSA (Forst.). _156.
Great Gray Owl.

Synonyms: *Syrnium cinereum*, *Ulula cinerea*, *S. lapponicum* var. *cinereum*, *Strix cinerea*. *Scotiaptex cinerea*.
Spectral Owl.

Kirkpatrick, Ohio Farmer, VIII, 1859, 107.

The records given by Dr. Wheaton remain the only ones for the state. They are: Mr. Kirkpatrick, Huntsburg, Geauga county; and Mr. Charles Dury, Clarke county. It must therefore be regarded as a casual visitor.

142. (372.) NYCTALA ACADICA (Gmel.). 157.
Saw-whet Owl.

Synonyms: *Nyctale acadica*, *Strix acadica*, *Ulula acadica*.
Acadian Owl.

Audubon, Orn. Biog., II, 1834, 537.

This little owl, the smallest of the group in Ohio, is almost wholly a winter resident in the state, breeding only rarely in the northern counties. It is probably more numerous than the reports show, for it is the most strictly nocturnal of the owls, and therefore seldom seen. Its small size is also a good protection from prying eyes. Like the Barred Owl, it has no ear tufts. It seems partial to evergreen

woods, but has been found on several occasions in an out-house of one of the lake summer resorts. The most of the reports of its occurrence fall within the colder part of the year, but it has been seen at Cincinnati in May (Dury), and it was found in May at Licking reservoir (Dawson).

"The food of this little Owl is composed almost wholly of mice, of which the wood-dwelling species seem to predominate. At times it attacks larger mammals, such as rats, half-grown red squirrels and chipmunks. . . . It rarely molests small birds, unless its favorite food—mice—for some reason, is scarce. Occasionally it feeds on scraps of raw or cooked meat which it has been observed to pick up in the vicinity of camps, and in winter, in the north, it will feed on the carcasses of comparatively large animals. . . . It also feeds to some extent on insects of various kinds. Thus it will be seen that while the diminutive size of the Saw-whet limits its powers of usefulness, its mode of life renders it a useful adjunct to the farmer, and, small though it be, yet in districts where it abounds the number of mice it annually destroys must be very large." (Fisher.)

143. (373.) MEGASCOPS ASIO (Linn.). 158.
Screech Owl.

Synonyms: *Scops asio*, *Strix nævia*.

Mottled Owl, Little Horned Owl, Red Owl.

Kirtland, Ohio Geol. Surv., 1838, 161, 179.

This is one of the most numerous and best known of our owls, and is the bird from which most persons get their idea of what an owl is like. In the more settled districts this owl seems to prefer to live in buildings other than dwellings, or in hollow shade trees. There are numerous instances of captures during the evening church service which, from all accounts, left neither the owl nor the audience in a worshipful frame of mind! The natural home of the Screech Owl is the deeper woods, where it frequently roosts and always nests in hollows in trees. It also spends the day in some thick foliated tree. On the Oberlin College campus a male is in the habit of spending the day in

an evergreen near the main walk leading from the Library to the Chapel building. His presence would never be suspected if the Blue Jays would mind their own business instead of his. This pair rears its brood in the loft of either French Hall or the Chapel.*

This little owl may be known by its conspicuous ear tufts and reddish or grayish mottled plumage. Its quavering call is often heard during the spring months.

"Their food consists of a great variety of animal life, including mammals, birds, reptiles, batrachians, fish, crustaceans, and insects. . . . Their economic relations, therefore, are of the greatest importance, particularly on account of the abundance of the species in many of the farming districts, and whoever destroys them through ignorance or prejudice should be severely condemned." (Fisher.)

144. (375.) BUBO VIRGINIANUS (Gmel.). 159.
Great Horned Owl.

Synonyms: *Strix virginianus*.

Hoot Owl, Cat Owl, Hooter.

Wilson, Am. Orn., 1812, 52.

This is the largest of our "horned" owls, and is generally reported as fairly common but disappearing near the large cities. It is rare in Lorain county, but three individuals being known in the western half of the county. Its large size should make it a conspicuous bird. I have found it only when crows and hawks have routed it from its retreat. It inhabits the larger, heavier woods, and is hardly more than semi-nocturnal, sometimes feeding by day. It nests indifferently in open nests or hollow trees.

It may be known at a glance by its white throat patch, large ear tufts, and powerful build.

"The food of this species is of great variety; birds and mammals as well as reptiles, fish, crustaceans, and insects contribute to its fare. Among the birds most often taken may be mentioned all kinds of poultry (including half-

*Since the above was written the chapel has burned. I am glad to report that the owl escaped unscorched.

grown turkeys), grouse, quail, doves, and wild ducks. Even hawks, crows, and other owls do not escape the voracity of this tiger among birds, and the large hawks are among those attacked and eaten.

"Of all the birds of prey, with the exception possibly of the Goshawk and Cooper Hawk, the Great Horned Owl is the most destructive to poultry. All kinds of poultry seem to be taken, though when Guinea fowls and turkeys are obtainable it shows a preference for these." (Fisher.) While this bird does a great deal of good in ridding the country of injurious animals, its natural taste for poultry sounds its death knell. We must feel a sort of compassion for him in his unequal struggle for life. He sees no reason for changing his manner of life and we cannot overlook his failings.

145. (376.) *NYCTEA NYCTEA* (Linn.). 160.

Snowy Owl.

Synonyms: *Nyctale scandica*, *Nyctea scandiaca*, *N. nivea*, *N. scandiaca* var. *arctica*, *Surnia nyctea*.

White Owl.

Wilson, Am. Orn. IV, 1812, 53.

The Snowy Owl visits the state only in winter and even then in small numbers unless there be some special provocation in the matter of failure of food supply farther north. It occasionally wanders completely across the state, but is clearly more numerous along the lake shore than in the interior. It also seems to be more numerous in the western third than farther east. We could hardly expect to find it except when the ground is covered, and the weather cold.

This bird is not pure white, but so near that color as to appear white. No one would confuse it with any other species of birds.

The favorite food of this large, smooth-headed owl seems to be mice and other rodents and fish. Its numbers in Ohio are too small to make it of any appreciable benefit, but it must be regarded as more beneficial than injurious. It probably does eat birds, and may even catch poultry on a pinch, but the numbers captured are very small.

146. (377a.) *SURNIA ULULA CAPAROCH* (Müll.). 161.
American Hawk Owl.

Synonyms: *Surnia ulula* var. *hudsonia* *S. funerea*, *S. ulula*,
Strix ulula, *S. hudsonia*, *S. caparoch*.

Hawk Owl, Day Owl.

Kirkpatrick, Ohio Farmer, VIII, 1859, 67.

The above reference and the remark that "Mr. Langdon thinks that he has seen this species at St. Mary's reservoir," are all that Dr. Wheaton knew of this species as an Ohio bird. There is a specimen in Mr. R. E. Jump's collection, captured near Oberlin some twenty years ago. Messrs. C. H. Morris and E. J. Arrick report one in Morgan county during the winter 1901-02, which was not captured. It therefore appears that the only specimen which can be examined is the Jump specimen.

This owl is so named because in appearance and habits of feeding it resembles a hawk more closely than an owl. In habits it is almost wholly diurnal, feeding and flying from place to place in broad day.

While in the state its food consists of small mammals and birds. It is probably somewhat injurious, but its numbers are so small as to count for nothing economically.

ORDER COCCYGES. Cuckoos and Kingfishers.

SUBORDER CUCULI. Cuckoos.

Family CUCULIDÆ. Cuckoos.

147. (387.) *COCCYZUS AMERICANUS* (Linn.). 149.
Yellow-billed Cuckoo.

Synonyms: *Cuculus americanus*.

Rain Cuckoo, Rain Crow, Rain Pigeon, Wood Pigeon, Cow-cow, Indian-hen.

Kirtland, Ohio Geol. Surv., 1838, 162.

This is the commoner of the two cuckoos in Ohio, and seems to be pretty uniformly distributed over the state during the summer. There is no evidence of an appreciable change in numbers since Dr. Wheaton's catalogue was published.

It is well known that the cuckoos are fond of the "hairy" caterpillars, and destroy great numbers of them. I have seen one bird disposed of a moderate sized colony of tent caterpillars at one sitting, in the nesting season. Both cuckoos deserve protection and good treatment for their services in ridding us of many insects which most other birds will not touch.

This is the darker of the two species, and in flight the wings show the rufous of the inner vanes of the feathers. The call is on a lower key, is given slower and is not phrased. It is only after some experience with the cuckoos that one can hope to be certain which species he has afield.

The migration records are far from satisfactory. They make it appear that the first arrive in the state shortly after the first of May and the last tarry until the third week in September. I have to say, however, that I have repeatedly found nests with eggs almost ready to hatch the first week in May, thus indicating an early April arrival.

148. (388.) COCCYZUS ERYTHROPHthalmus (Wils.).
150.

Black-billed Cuckoo.

Synonyms: *Cuculus erythrophthalmus*.

Rain Crow, Rain Dove, Chow-chow, Cow-cow.

Audubon, Orn. Biog., I, 1831, 170.

Dr. Wheaton's statement that this cuckoo is a very common summer resident throughout the state is no longer applicable. The reports from observers are nearly uniform in pronouncing it decidedly less common than the preceding species. In habits it is practically the same as the Yellow-billed. The cry is phrased instead of being uttered in a uniform monotone.

SUBORDER ALCYONES. Kingfishers.

Family ALCEDINIDÆ. Kingfishers.

149. (390.) CERLYLE ALCYON (Linn.). 148.
Belted Kingfisher.

Synonyms: *Alcedo alcyon*.

Kingfisher, Fisher.

Wilson, Am. Orn., III, 1811, 59.

The Kingfisher is a resident in favorable places, where open water may be found the winter through, and where fish are plentiful; but it is not known as a winter bird from most localities, simply because open water is not found in the coldest weather. In Lorain county there is no open water, regularly, even along the lake shore, where fish can be found;* but at Norwalk a pool which is fed by warm water from a manufacturing plant furnishes at least one Kingfisher with winter rations. In the southern part of the state it is more commonly found all winter and summer. Migrants reach Oberlin about the middle of March.

The Kingfisher feeds entirely upon fish, but cannot be considered in any degree injurious to the fishing industry.

*Since the above was written a pool of open water has been discovered about two miles north of Elyria where a Kingfisher spends the winter.

ORDER PICI. Woodpeckers, Sapsuckers and Flickers.

Family PICIDÆ. Woodpeckers.

150. (393.) DRYOBATES VILLOSUS (Linn.). 140.
Hairy Woodpecker.

Synonyms: *Picus villosus*, *P. rubricapillus*.

"Sapsucker."

Kirtland, Ohio Geol. Surv., 1838, 162.

This is a common resident throughout the state, but apparently is less common in summer than in winter. Its secretive habits during the nesting season probably give a false impression. This and the next species frequent the

orchards and shade trees during the winter and spring, sometimes nesting in old apple trees. Their search after insects within the bark of trees has earned for them the mistaken title of Sapsucker, and with the title a measure of persecution. It is doubtful whether either of these birds have ever done as much damage as good to the tree from which they have taken injurious insects. Wood-boring beetles, both adults and larvæ, caterpillars, mostly tree-burrowing, and wood-boring ants comprise the chief summer food. It is therefore clear that this woodpecker is one of our best preservers of the forests. In winter they may eat nuts, frozen fruit, and weed seeds when insects are hard to find. They also eat the inner bark of some trees.

There seems to be no direct evidence that this and the next species migrate at all.

151. (394c.) *DRYOBATES PUBESCENS MEDIANUS* (Swains.).
141.

Downy Woodpecker.

Synonyms: *Picus pubescens*, *P. medianus*, *Dryobates pubescens*.

"Sapsucker," Little Sapsucker, Small Sapsucker.

Kirtland, Ohio Geol. Surv., 1838, 162, 179.

This is the more familiar and better known of our two small winter woodpeckers. A little encouragement in the way of broken nut meats or suet tied or nailed to some tree or board placed for that purpose, will make him a regular winter visitor even to the window sill. In summer he is likely to choose a useless apple tree for his nest, if not startled away.

This and the preceding species troop through the woods, in winter, with the Chickadees, Tufted Tits, Nuthatches, and Goldfinches, and often others, making an otherwise dreary waste of timber full of life and interest.

In habits this little woodpecker resembles the Hairy closely, eating the same kind of food. It may be known from the Hairy by its smaller size and weaker bill, and higher pitched voice.

152. (400.) *PICOIDES ARCTICUS* (Swains.). 142.
Arctic Three-toed Woodpecker.

Synonyms: *Picus* (*Apternus*) *arcticus*.

Black-backed Woodpecker, Black-backed Three-toed Woodpecker, Ladder-backed Woodpecker, Banded-backed Three-toed Woodpecker.

Wheaton, Ohio Agri. Report, 1860, 379, hypothetical.

Baird, Brewer, Ridgway, II, 1874, 531.

The specimen reported by Dr. Brewer in the second citation above, was taken at Akron, Summit county. Oberlin College has since come into possession of a specimen collected and mounted by Mr. John C. Catlin at Ravenna, Portage county. It is not unlikely that Mr. Catlin secured his specimen first, but this is the first mention of it in print.

Prof. J. S. Hine, of Columbus, gives it as occasional in Franklin county.

It would occur only in severe winters.

153. (402.) *SPHYRAPICUS VARIUS* (Linn.). 143.
Yellow-bellied Sapsucker.

Synonyms: *Picus varius*.

Yellow-bellied Woodpecker, Sapsucker, Common Sapsucker.

Wilson, Am. Orn., I, 1808, 147.

This is the true "Sapsucker," and should not be confused with our familiar winter woodpeckers. It feeds upon the sap of the maple and pine trees in spring, and often causes some damage to the trees, sometimes girdling the tree with one or more rows of holes. It is undoubtedly true that the insects which swarm about the exuding sap are also eaten, so the object which the woodpecker has in view in tapping the tree may be twofold. During the rest of the year the birds eat insects, some mast, the inner bark of trees, and such vegetable food as can be found.

It is common as a migrant across the state, both spring and autumn, but nests in small numbers in the northern part of the state. It winters in small numbers in the southwest corner, reaching the lake shore in the northward migration during the middle of March. It crosses the state

again during the first half of October. A few individuals remain in almost any locality all winter.

154. (405a.) *CEOPHLÆUS PILEATUS ABIETICOLA* Bangs.
144.

Northern Pileated Woodpecker.

Synonyms: *Hylotomus pileatus*, *Picus pileatus*, *Ceophlæus pileatus*.

Pileated Woodpecker, Logcock, Woodcock, Big Black Woodpecker, Black Woodpecker, King of the Woods, Cock of the Woods.

Kirtland, Ohio Geol. Surv., 1838, 162.

The decrease in the numbers of this species heralded by Dr. Wheaton in 1882, has gone on steadily, but less rapidly than during his long term of study. From all reports it is now almost gone from the northwestern parts of the state, but can be found in the eastern and middle-southern parts where some heavy timber is still allowed to stand. The cutting down of a large tract of swampy woods in Ashtabula county has driven some of the birds remaining there to the woods surrounding Jefferson, where Mr. Robert J. Sim enjoyed the rare opportunity of watching a pair at their household affairs during last spring. The writer saw the tree, in September of the same year, and listened to the weird laugh of the birds. If the woods are doomed the Pileated Woodpecker's days are numbered. We cannot but mourn the passing of this majestic "King of the Woods."

The food consists principally of the larvæ of wood-boring beetles, ants, and wild fruits. It is, therefore, one of our best forest preservers.

155. (406.) *MELANERPES ERYTHROCEPHALUS* (Linn.) 146.
Red-headed Woodpecker.

Synonyms: *Picus erythrocephalus*.

Red-head, Tricolor.

Kirtland, Ohio Geol. Surv., 1838, 162.

The Red-head is one of our commonest summer birds. It may fairly be called abundant after the young have left the

nest, and until the first frosts give warning of the coming winter. It reaches southern Ohio about the 25th of April, and the northern counties within three days afterward. Frequently a few individuals remain all winter even at the lake shore, but the majority have left the northern regions before the last of September.

The Red-head is not quite a true woodpecker, since he does not search the bark of trees for insects and worms as much as he looks for them on posts and such surfaces, but he has developed the flycatcher habit of darting out for flying insects, catching them as adroitly as any Kingbird. The late General J. D. Cox told with evident relish how as a boy he took advantage of this flycatching habit to catch the bird. By tossing a small stone up past the bird alert upon the top of some broken topped dead tree, as the stone fell downward the bird would invariably dart out to catch it, but was stunned and fluttered to the ground only to be pounced upon and carried off in triumph by the young general!

"The Red-head makes the best showing in the kinds of insects eaten. It consumes fewer ants and more beetles than any of the other species, in this respect standing at the head, and it has a pronounced taste for beetles of very large size. Unfortunately, however, its fondness for predaceous beetles must be reckoned against it. It also leads in the consumption of grasshoppers; these and beetles together forming 36 per cent. of its whole food." (Beal.) It also eats a little corn, a good deal of wild and cultivated fruit, and beech-nuts. It does not injure trees by pecking them. The nest is dug out of almost any woody substance, preferably a tree, but frequently a post will do as well.

156. (409.) CENTURUS CAROLINUS (Linn.). 145.

Red-bellied Woodpecker.

Synonyms: *Melanerpes carolinus*, *Picus carolinus*.

Zebra Bird, Guinea Woodpecker, Carolina Woodpecker, Checkered Woodpecker, Zebra Woodpecker, Orange Woodpecker or Sapsucker.

Wilson, Am. Orn., I, 1808, 113.

The Red-bellied Woodpecker is fairly common in the

southern part of the state, but less numerous in the northern part. It is a resident everywhere, nesting in the deeper woods.

In addition to its usual diet of insects and worms it is a lover of ripe apples, and in winter finds acorns and beech-nuts good forage. It has been detected in the act of storing away acorns and nuts for winter consumption.

157. (412a.) *COLAPTES AURATUS LUTEUS* Bangs. 147.
Northern Flicker.

Synonyms: *Colaptes auratus*, *Picus auratus* *Cuculus auratus*.
Golden-winged Woodpecker, Flicker, High-holder. For the remainder of the 125 English synonyms see "The Wilson Bulletin," No. 31, for sale by the author at 25 cents a copy.
Kirtland, Ohio Geol. Surv., 1838. 162.

The Flicker is probably strictly migratory in its habits, in spite of the fact that it is resident throughout the state—in small numbers in the north, common in the south. It is abundant as a migrant, but hardly more than common during the nesting season. In winter it will eat anything that can be found. In summer it seems to crave ants, of which it consumes quantities. During harvest days it becomes lazy and then feeds on the ground like a Meadowlark, catching the young grasshoppers and crickets and fattening upon them. It must be classed among the distinctly useful birds, both as a destroyer of insects and as an alarm clock if you have been so unwise as to cover any part of your roof with tin! 3:30 in spring, 4:00 in summer and 4:30 in autumn are the hours which he loudly heralds for the beginning of day. You can't drive him away.

The migrating host of Flickers reaches northern Ohio during the third week in March. Its numbers are considerable up to the middle of October, or even the first of November.

ORDER MACROCHIRES. Goatsuckers, Swifts, Humming-birds.

SUBORDER CAPRIMULGI. Goatsuckers.

Family CAPRIMULGIDÆ. Nighthawk and Whippoorwill.

158. (417.) *ANTROSTOMUS VOCIFERUS* (Wils.). 138.
Whip-poor-will.

Synonyms: *Caprimulgus vociferus*.
Night-Jar.

Kirtland, Ohio Geol. Surv., 1838, 162, 180.

The Whip-poor-will is decidedly local in its distribution, being common at one place and unknown at another not far away, with no apparent reason. It is strictly nocturnal in habits, and is therefore more often heard than seen. Even when flushed in daylight it flies but a few rods and settles down again, trusting to its protective coloration for concealment. So perfectly does its plumage and posture simulate a part of a log, or a knot on a log, that it is perfectly hidden from all but practiced and discriminating eyes. Being strictly insectivorous it is strictly migratory in habits, reaching southern Ohio during the third week in April and the northern counties shortly after the first of May. It has left the state by September 22.

In northern Ohio one must look for the Whip-poor-will in the wilder and rougher parts of the region. River gorges and rocky bluffs may harbor numbers of pairs.

159. (420.) *CHORDEILES VIRGINIANUS* (Gmel.). 139.
Nighthawk.

Synonyms: *Chordeiles popetue*, *Caprimulgus virginianus*, *C. popetue* var. *popetue*.

Bull Bat, Goatsucker, Night Jar, Mosquito-hawk, Pisk.
Kirtland, Ohio Geol. Surv., 1838, 162.

Contrary to its name, the Nighthawk is not strictly nocturnal, but is rather a bird of the twilight and dark days, but it is frequently seen at broad day, particularly during the season of southward migration. It is more numerous dur-

ing twilight, when it may be seen leisurely flitting about in crazy fashion gathering its harvest of flying insects, with an occasional quick dart here or there after some larger and quicker prey. It is strictly migratory, reaching our southern border about the first of May, and the lake shore a week later; departing southward again about the middle of September. It is thus a little later in appearing and a little earlier in leaving than Whip-poor-will.

In northern Ohio, at least, it seems to nest preferably on the tops of our taller city buildings. I have yet to learn of a nest that has been found in the woods within thirty miles of Cleveland.

The Whip-poor-will and Nighthawk take up the destruction of insects where the swallows and flycatchers leave it. We could wish there were more of all kinds of insect eaters, particularly those which feed at night.

SUBORDER CYPSELI. Swifts.

Family MICROPODIDÆ. Swifts.

160. (423.) CHÆTURA PELAGICA (Linn.). 137.

Chimney Swift.

Synonyms: *Hirundo pelasgia*, *H. pelagica*, *Cypselus pelasgius*, *Chætura pelasgica*.

Chimney Swallow, Common Swift, Swift.

Wilson, Am. Orn., V, 1812, 48.

This familiar bird is pronounced abundant over the entire state. It nests in the smaller chimneys, and roosts in communities in the larger chimneys. I find no records of nesting in hollow trees. Dr. Wheaton speaks of the probability that a few pairs nested in an old hollow tree three miles east of Columbus, prior to 1882.

The Swifts reach Ohio about the middle of April, and seem to distribute themselves pretty generally at once. Migration dates for the southern and northern counties do not differ materially. They do not leave the vicinity of Oberlin until mid-October, sometimes lingering well into the third week.

Presumably the Swifts must rest at some time, but when seems a mystery. We see them only on the wing, never perched, unless it be in a chimney near or on the nest. Of course their food consists entirely of flying insects captured while flying. No one ever questioned the usefulness of this strong-winged bird.

SUBORDER TROCHILI. Hummingbirds.

Family TROCHILIDÆ. Hummingbirds.

161. (428.) TROCHILUS COLUBRIS Linn. 136.

Ruby-throated Hummingbird.

Kirtland, Ohio Geol. Surv., 1838, 164.

This is the only Hummingbird which ever visits Ohio. It is common all summer over the entire state, nesting either near dwellings or in the woods as fancy may dictate. The head contains no poison gland, so the thrust of the beak is not poisonous unless the bird has just been feeding upon some plant whose blossom is poisonous.

The Hummingbird is not one of the strongest winged birds, but frequently perches for rest. It has brought to perfection the art of hovering and darting as well as forward flight, but cannot soar. It is a great fighter in its way, easily putting to rout Catbirds, Robins and Blue Jays; not by striking with either wings or beak (its feet are too small and weak to be used in that way), but by hovering and dancing close to the bird which it chooses to put to flight. The buzzing, jiggling movement seems to confuse its adversary.

The Hummer reaches our southern border about the first of May, but is a week later at the lake shore. It leaves the state about the middle of September, often tarrying a little longer at the south.

Probably no bird could long live upon a diet of honey alone. It must certainly be true that the Hummingbird eats honey, because its tongue is made that way, but it is just as true that it eats insects which it finds in the blossoms with the honey. It is therefore a useful bird as well as a pleasing feature of our flower gardens.

ORDER PASSERES. Perching Birds.

SUBORDER CLAMATORES. Songless Perching Birds.

Family TYRANNIDÆ. Tyrant Flycatchers.

The birds which belong to this family are præëminently flycatchers, but while they feed so largely upon flying insects, catching them in mid-air by a sally from some position where they have been waiting, they also eat wild fruits in their season to some extent. Sometimes they descend to the ground to pick up insects seen there. The only member of the family about which complaints have been made is the Kingbird. He is fond of honey bees, and will sometimes nearly destroy a hive if not interrupted in his feast. As a group the flycatchers are among our most useful insect destroyers, supplementing the work of the swallows and Nighthawk, Whip-poor-will, and Chimney Swift.

162. (444.) TYRANNUS TYRANNUS (Linn.). 127.
Kingbird.

Synonyms: *Tyrannus carolinensis*, *T. intrepidus*, *Muscicapa tyrannus*, *Lanius tyrannus*.

Bee Martin, Bee Bird, Tyrant Flycatcher, Tyrant.
Kirtland, Ohio Geol. Surv., 1838, 163.

The Kingbird is well known to all. It is common during the summer in all parts of the state. While it may be harmful in some individual cases to bee raisers, it is a decidedly useful bird in general.

The Kingbird reaches the Ohio river about April 20, and Lake Erie five days later. It remains only until the first week in September.

163. (452.) MYIARCHUS CRINITUS (Linn.). 128.
Crested Flycatcher.

Synonyms: *Muscicapa crinita*, *Tyrannus crinitus*.

Great Crested Flycatcher.
Kirtland, Ohio Geol. Surv., 1838, 163.

This bird is almost as well known as the Kingbird, from which it may be easily distinguished by the reddish instead

of white-tipped tail. It has taken a notion to the orchards, frequently nesting in the hollow apple trees, in spite of the English Sparrow.

Its arrival follows that of Kingbird within five days, both in the south and north. It generally lingers longer in autumn, not infrequently tarrying until mid-October at Oberlin.

164. (456.) *SAYORNIS PHŒBE* (Lath.). 129.
Phœbe.

Synonyms: *Sayornis fuscus*, *Muscicapa fuscus*, *Tyrannus fuscus*.
Pewee, Pewit, Bridge Pewee, Water Pewee, Pewit Flycatcher, Phœbe Bird, Barn Pewee, House Pewee.

Kirtland, Ohio Geol. Surv., 1838, 163.

The Phœbe is almost a household bird in many parts of the state, nesting in barns and out-buildings. It also selects bridges, but still clings to its ancient nesting places when possible. Almost any rocky bluff furnishes a home for one or more pairs of Phœbes, whether a river gorge, a deserted quarry, or a natural rock face.

While a true flycatcher it is one of the early spring birds, not infrequently announcing its arrival before the 20th of March at the lake shore. It rarely departs for the south before the leaves have fallen from the trees, which is late October.

During the cold, snowy days of late March I have found Phœbe in the deep woods gleaning from the blossoms of the witch-hazel, or apparently eating the buds from a linden tree.

165. (459.) *NUTTALORNIS BOREALIS* (Swains.). 130.
Olive-sided Flycatcher.

Synonyms: *Sayornis borealis*, *Tyrannus borealis*.
Wheaton, Ohio Agri. Report, 1860, 1861, 379, 480.

I find no records for this flycatcher east of Clarke county. While Dr. Wheaton throws some doubt upon the admissibility of the records upon which he gave the species a place in his catalogue, except Dr. Langdon's statement for 1877,

there can be no reasonable question that it is a rare migrant in the western third of the state.

166. (461.) *CONTOPUS VIRENS* (Linn.). 131.

Wood Pewee.

Synonyms: *Muscicapa virens*, *Tyrannus virens*.

Pewee, Pewee Flycatcher.

Kirtland, Ohio Geol. Surv., 1838, 163.

Wood Pewee is more than common. In northern Ohio it is easily the most numerous of any of our flycatchers, because found everywhere where there are trees, except in the deep woods, and where found it is too numerous to escape the notice of the most inattentive. Its plaintive call must be familiar to every one. It is probably less numerous in the more hilly south-eastern parts of the state.

Wood Pewee is among the later arrivals from the south, rarely appearing in the southern counties before May 5th, and in the north not seldom as late as the 10th. It remains with us in Lorain county until the middle of September, but tarries until October along our southern border.

167. (463.) *EMPIDONAX FLAVIVENTRIS* Baird. 132.

Yellow-bellied Flycatcher.

Synonyms: *Tyrannula flaviventris*.

Kirkpatrick, Ohio Farmer, IX, 1860, 139.

Dr. Wheaton speaks of this species as "A common spring and fall migrant," apparently meaning over the entire state. I have never found it in Lorain county, although it has been taken there. It is not well known if a common migrant. Probably it has greatly decreased in numbers since Dr. Wheaton laid down his work. I find no records of its breeding within the state.

Dr. Wheaton states that this flycatcher is different in habits from the other small flycatchers, in that it frequents fence-rows and is timid, darting into a thicket and remaining hidden when one approaches. This may account for its apparent scarcity.

168. (465.) *EMPIDONAX VIRESCENS* (Vieill.). 133.

Green-crested Flycatcher.

Synonyms: *Empidonax acadicus*, *Tyrannus acadicus*, *Platyrhynchus virescens*.

Acadian Flycatcher, Small Green-crested Flycatcher.

Kirtland, Ohio Geol. Surv., 1838, 163.

Apparently more pairs of this woods haunting flycatcher nest in the northern half of the state than in the southern half. It is fairly common everywhere, but may almost be called abundant in the heavier woods in the north. Its small size and weak voice cause it to be overlooked by many who should know it.

In its northward migration it reaches the lake shore about the first of May, and does not return south before the second week in September.

169. (466.) *EMPIDONAX TRAILLII* (Aud.). 134.

Traill Flycatcher.

Synonyms: *Empidonax pusillus traillii*, *Tyrannus traillii*, *Muscicapa traillii*.

Little Flycatcher.

Read, Fam. Visitor, III, 1853, 359.

This is another little known species, probably rather because it is so difficult to distinguish between the small flycatchers unless one knows the song, than because the bird is rare. As a migrant it seems to be fairly common in most counties, but only a few remain to breed in the southern tier of counties. I found it breeding in considerable numbers at Licking reservoir and at Lewiston reservoir. It prefers a willow or alder fringed lake or marsh for its summer home. A short distance from such places it may not be found at all.

This is one of the last of the migratory birds to appear; sometimes not reaching northern Ohio before the middle of May, rarely before the 10th day. It is gone again by the first of September.

170. (467.) *EMPIDONAX MINIMUS* Baird. 135.
Least Flycatcher.

Synonyms: *Tyrannus acadicus*, *Tyrannula minima*.

Chebec, Sewick.

Read, Family Visitor, III, 1853, 359.

While this is common as a migrant throughout the state it appears to be rare as a summer resident, especially in the south. I have yet to find a pair breeding in Lorain county. It is, however, given as breeding in Erie county, and as possibly breeding in Scioto county by Rev. W. F. Henninger. It seems likely that it is local in its summer distribution. In August we found it along the Ohio river from Marietta to Ironton.

The Least Flycatcher reaches Lorain county by the 25th of April and departs about the first of September.

SUBORDER OSCINES. Song Birds.

Family ALAUDIDÆ. Larks.

The true larks are found in flocks of from a few to several hundred individuals except during the breeding season. Their food consists of weed seeds and such grains as may be scattered in the fields or by the roadside, and the eggs and larvæ of insects. Probably adult insects are also eaten to some extent. They are useful birds.

171. (474.) *OTOCORIS ALPESTRIS* (Linn.). 126.
Horned Lark.

Synonyms: *Eremophila alpestris*, *E. cornuta*, *Alauda alpestris*.
Shore Lark.

Kirtland, Ohio Geol. Surv., 1838, 164; 183.

It is unfortunate that so few persons are able to distinguish certainly between our three forms of *Otocoris*. The evidence seems to be pretty clear that there has been a shifting about of *alpestris* and an invasion of *praticola* since Dr. Wheaton wrote in 1882. He was familiar with the winter bird but knew nothing of the summer form, which he would have known had it been as common as it is now.

"Abundant winter resident" is the term he applies to *alpestris*, the form known to him. After an experience of twelve years in Lorain county I would not consider it more than common. In 1882 it apparently ranged completely across the state, but now there are no extreme southern records. This, again, may be due to unfamiliarity with the birds. At any rate it is more common north than south. I have seldom seen true Horned Larks before the first considerable cold wave which brings snow. This may be late in November or not until the second week in January. Most of the Horned Larks have gone north by the middle of March, but individuals sometimes tarry until early May.

During the winter the Horned Lark is largely a seed eater, and destroys quantities of noxious weeds in embryo. During the period of snow covered landscape he searches out the freshly spread manure, or goes into the pastures where fodder has been scattered, picking up what the cattle have left or uncovered. Flocks of several hundred are not uncommon at such times.

172. (474b.) *OTOCORIS ALPESTRIS PRATICOLA* Hensh. —
Prairie Horned Lark.

Dwight, Auk, VII, 1890, 145.

This is the first specific reference. In a general way Henshaw covered Ohio in his review in 1884, but made no specific reference to Ohio. This form was not elaborated until two years after Dr. Wheaton had seen his catalogue out of the press, but since he makes no mention of the breeding of the Horned Lark it seems likely that he did not know this form. It is very probable that it invaded the state just after Dr. Wheaton laid down his work.

O. a. praticola is now the common resident form nearly throughout the state. It is naturally more numerous in the more level northern and western parts than in the rougher south-eastern. Naturally it is confused with *alpestris* by many of the Ohio men, particularly those who are familiar with the earlier classification which Dr. Wheaton used.

In general habits this form agrees with *alpestris*. During

the summer, particularly the breeding season, the regular diet of weed seeds is supplemented with insect larvæ.

Since these birds may usually be rather closely approached during the winter when they associate together, and always head into the wind, they may be readily distinguished by the yellow line above the eye in the true Horned Lark, and by the white line, with no trace of yellow, in Prairie Horned Lark. Both have yellow or yellowish throats, Horned Lark the brighter and clearer. The form *hoyti* is as large as *alpestris*, but is lighter than *praticola*, and with no yellow over the eye.

173. (474k.) *OTOCORIS ALPESTRIS HOYTI* Bishop. —.
Hoyt Horned Lark.

Synonyms: *Otocoris alpestris leucolema*.

Oberholser, A Review of the Larks of the Genus *Otocoris*, Proceedings of the U. S. National Museum, XXIV, No. 1271, 812.

The specimen above referred to, captured at Wooster, one in the Oberlin College collection, and at least three in the collection of the Ohio State University, are all of which I have any record. A critical examination of local collections may reveal others. The recent elaboration of this subspecies makes it impossible to say what its status in our state is. From the small amount of evidence I would infer that it is a winter visitor with the Horned Lark, ranging into the state from the north-west.

Family CORVIDÆ. Crows, Jays, Magpies, etc.

The food habits of the three representatives of this family which occur in Ohio are given under the species.

174. (477.) *CYANOCITTA CRISTATA* (Linn.). 125
Blue Jay.

Synonyms: *Cyanurus cristatus*, *Cyanura cristata*, *Corvus cristatus*, *Garrulus cristatus*.

Jay Bird.

Kirtland, Ohio Geol. Surv., 1838, 162.

Blue Jay is a familiar and common resident throughout the state except in the south-eastern portion. He is usually

more in evidence during the winter than during the summer, no doubt because he finds food more plentiful and more easily obtained in towns and cities. During the winter the jay is a great scavenger, visiting the kitchen waste barrel regularly. He will eat almost anything that can be digested, and sometimes other things as well. Corn and nuts furnish a good share of his winter food, where they are plentiful. His friends keep still about what he eats during the summer. There is no doubt that many nests despoiled of eggs or even young must be laid to his mischievous propensities. One might be allowed to judge of his character by the manner in which his neighbors receive him. The appearance of a jay in any neighborhood is the signal for all the birds to band together to drive him away. Prof. F. E. L. Beal's examination of 292 stomachs failed to sustain the almost universal testimony of the robbing proclivities of this bird. There was some evidence of it but too little upon which to base a sweeping condemnation. On the other hand, the Blue Jay certainly does destroy large numbers of injurious insects.

While it is probably true that the Blue Jay is migratory to some extent, the northernmost birds receding south a greater or less distance to spend the winter, and the others also crowding south to give place to them, it is not an appreciable movement in Ohio.

175. (486a.) *CORVUS CORAX PRINCIPALIS* Ridgw. 123.
Northern Raven.

Synonyms: *Corvus corax*, *C. corax* var. *carnivorous*, *C. carnivorus*.

Raven, American Raven.

Wilson, *Am. Orn.*, IX, 1825, 136.

The records seem to indicate that in Wilson's time the Raven was so common along the lake shore, particularly easterly, as to entirely supplant the Crow. It gradually decreased in numbers, until none were known except in the extreme northwest. In 1882 Dr. Wheaton regarded it as a "Rare winter visitor." Mr. Thos. Mikesell, of Wauseon,

is the only person who reports its occurrence at the present time. Other residents of Fulton county corroborate Mr. Mikesell's statement. Apparently it has been in the habit of nesting in that corner of the state and in the adjoining parts of Indiana. Doubtless the next decade will witness its complete extinction from the state.

176. (488.) *CORVUS AMERICANUS* Aud. 124.
American Crow.

Synonyms: *Corvus frugivorus*, C. *corone*.

Crow, Common Crow.

Kirtland, Ohio Geol. Surv., 1838, 162.

Our common Crow is resident in some numbers in the southern portion of the state, and may be found in small numbers in favorable places even to the lake shore. Cold, snowy winters are likely to drive most if not all individuals south at least to the center of the state. The northward movement of the Crow host reaches Lorain county early in March, but it is almost wholly dependent upon weather conditions. Not infrequently small companies of these birds may be seen moving north during the last week of February. Considerable numbers remain well into December in all but exceptionally cold winters which begin early.

It is well known that the Crow is a social bird to an unusual degree, except when nesting. Crow "Roosts" are readily located by noting the converging lines of flight during the afternoon in spring and fall, and in winter in the southern counties.

It would be superfluous to discuss the food habits of this interesting bird here. The reader can obtain an exhaustive paper upon the Crow by writing to the Secretary of Agriculture, Washington, D. C. The evidence which will be found there is slightly favorable to the Crow. But it must be admitted that during planting time he is a mischievous bird, and then may deserve a warm reception. But that he does eat many insects which destroy quantities of grain must also be freely admitted.

Family ICTERIDÆ. Blackbirds, Orioles, Meadowlarks, etc.

Most members of this family are among the best known of our birds, because they either live about dwellings or in our parks, or because they are conspicuous in either color or voice. Their food habits are discussed in detail under each species.

177. (494.) DOLICHONYX ORYZIVORUS (Linn.). 114.
Bobolink.

Synonyms: *Icterus agripennis*, *Fringula oryzivorus*.

Reedbird, Ricebird, White-winged Blackbird, Skunk Blackbird, Bob Lincoln, Butterbird, Ortolan, Meadow-wink, Maybird.

Nuttall, Manual, I, 1832, 185.

In his full wedding dress the Bobolink is a well-known bird, but in his traveling suit of drab and yellow he is to most persons a common sparrow. I was somewhat surprised to learn that while the Bobolink is one of our most familiar meadow inhabitants in northern Ohio, it is not found at all during the summer in the southern part, only passing through as a migrant twice a year. I found it breeding sparingly at both the Licking and Lewiston reservoirs. It is reported as common all summer as far south as Delaware, but apparently at the Licking reservoir it is near its southern breeding limit.

Being a meadow haunting bird, its appearance in the state must have followed the disappearance of the forests, except in the more open north-western counties. Dr. Wheaton places its first appearance in Geauga county in 1857.

Bobolink reaches Lorain county during the last week of April. The males change their garb during July and early August, after which the species may be found in flocks of varying size, making ready for their journey to the Florida rice fields. They are gone by the middle of September. In the southern part of the state they remain but about a week after their first appearance in spring, and return again during the second week in September, to remain but a few days.

With us the Bobolink is both interesting and useful. His irresistible burst of song is one of our treasures, and his destruction of insects and weed seeds makes him an aid to the farmer. But in the south he has found the rice fields a never failing source of food, and often pays the penalty of thieving with his life. The year through he is more useful than harmful.

178. (495.) *MOLOTHRUS ATER* (Bodd.). 115.

Cowbird.

Synonyms: *Icterus pecoris*, *Molothrus pecoris*, *Fringilla pecoris*.

Cowbird, Cow Blackbird, Cow Troupial, Cow Bunting, Common Cowbird, Chuckold, Blackbird, Shinyeye, Lazy Bird, Clodhopper, Buffalo Bird.

Kirtland, Ohio Geol. Surv., 1838, 162, 180.

It is hard to find anything good to say about this lazy tramp. He is, unfortunately, common all summer over the entire state, so that nowhere can the other birds find refuge from his depredations. We may have small pity for the stupidity of the other birds in permitting the alien egg to remain in their nests to work the destruction of their own young, but how different are we when we find a poor human waif which somebody may be too lazy to care for? Some birds, particularly the larger ones, do throw the egg out of their nest, but few of the smaller ones seem to make any effort to free themselves of the incubus. The presence of a young Cowbird in the nest of a species which is smaller than the Cowbird, frequently results in the death of the rightful inhabitants of the nest, and so great damage is done in the destruction of really beneficial birds.

There are perhaps two good things about the Cowbird. It eats the insects and grubs which are more or less injurious to cattle, and which are found in the pastures among the herds, and its flesh is good to eat! Cowbird and English Sparrow should find their way to the bill of fare of our hotels. They are dainty tidbits. Call them Ricebirds if you prefer.

The Cowbird reaches Ohio during the middle of March and returns south late in October. It frequently associates

with the Bronzed Grackles in their roosts during the summer and autumn, and may sometimes be found in the northward moving flocks made up of the several species of "Blackbirds." During the summer it is found in companies of five to eight individuals, both males and females, about the woodlands and pastures.

179. (498.) *AGELAIUS PHŒNICEUS* (Linn.). 117.
Red-winged Blackbird.

Synonyms: *Agelæus phœnicus*, *Icterus phœnicus*, *Oriolus phœnicus*.

Swamp Blackbird, Red-winged Starling, Red-and-buff-shouldered Marsh Blackbird, Blackbird.

Kirtland, Ohio Geol. Surv., 1838, 162.

This is probably the most familiar bird of the swamps and marshes in all parts of the state, where it nests in large numbers. In some regions where its natural nesting places of rushes and cat-tails have disappeared on account of drainage, it has gone into the clover fields and meadows. In others it has taken to the brush.

The testimony of the examination of large numbers of stomachs of this bird shows that it may prove harmful in some places and under some circumstances, but that its harmfulness is about one-eighth, as represented by the grains which it eats. The harmful insects and weed seeds which it destroys should far outweigh any damage done to agriculture. No doubt a large part of the grain eaten is waste grain.

The Red-wing is one of spring's harbingers. He reaches Ohio not far from the first of March, but is inclined to be a few days later than the Bluebird and Robin. When the season is late he may come in a large flock of "Blackbirds," but earlier he seems to prefer to travel with a small company of his own kind only. Like the other birds of his color he loves company, and after the young are able to fly, a whole swamp full select a place to spend the nights, which may be with the other species, or possibly a roosting-place exclusively of his own species. The most of our Red-wings

have gone south by the last of October, but a few remain well toward December, especially in the southern counties.

180. (498a.) *AGELAIUS PHENICEUS FORTIS* Ridgway.
Thick-billed Red-wing.

There is a specimen in the Oberlin College collection which seems clearly to belong to this new race. It was taken October 25, 1890, by C. A. Kofoed, at Oberlin. Apparently this form should be found among the early spring and late autumn Red-wings. The form has been so recently elaborated that it has not been possible to examine specimens in the different collections.

181. (501.) *STURNELLA MAGNA* (Linn.). 118.
Meadowlark.

Synonyms: *Sturnus ludovicianus*, *Sturnella ludoviciana*, *Alauda magna*.

Fieldlark, Old Fieldlark, Meadow Starling, Marsh Quail.
Kirtland, Ohio Geol. Surv., 1838, 162.

Like the Crow, Meadowlark may remain in small numbers in the northern part of the state all winter. Long continued cold, and particularly snow, will usually drive all south, or into some region not covered by snow. In the southern counties, decreasingly northward, it is a regular winter resident. No doubt the present condition of the Meadowlark is due to the clearing away of the forests, but unlike the Bobolink, it does not require so extensive fields and therefore probably found natural clearings in the forests possible breeding grounds before the appearance of the white settlers. If so his numbers were far less than now.

There should be no note of condemnation for this bird. His services in the meadow and fields cannot be estimated in values. Even during the winter insects comprise a large proportion of his food, while practically no grain that could be saved is eaten at any time. To say that 73 per cent. of the whole amount eaten is insects, a large part of which eat grains, is telling but half of the story. Being a ground haunter, the insects destroyed are such as the other birds

do not touch. It is therefore one of the birds which should be rigidly protected.

182. (506.) *ICTERUS SPURIUS* (Linn.). 119.
Orchard Oriole.

Synonyms: *Oriolus spurius*.

Kirtland, Ohio Geol. Surv., 1838, 162.

The Orchard Oriole is a fairly common summer resident throughout the state. In Lorain county it has increased, during the last ten years, from scarcely more than casual to fairly common. Writing in 1882, Dr. Wheaton states that in the vicinity of Columbus, at least, it resorts to "the low banks of sparsely wooded streams and willow thickets," preferring such places to orchards. In Lorain county it is more often found in orchards than elsewhere.

The birds are not numerous enough to figure economically, but if they were their food would be found to consist largely of insects injurious to fruit. The birds probably eat some ripe fruit in its season, but so little of it as to be of no consequence. Ripe mulberries are eaten with a good deal of relish.

The Orchard Oriole reaches our southern border during the last week in April and spends nearly a week in traversing the state, seldom appearing at Oberlin before the first of May. Its departure southward is a little uncertain, but seems to be about the middle of August.

183. (507.) *ICTERUS GALBULA* (Linn.). 120.
Baltimore Oriole.

Synonyms: *Icterus baltimore*, *Oriolus baltimore*, *Coracias galbula*.

Golden Robin, Hangnest, Firebird, Peabird, Hanging-bird.
Kirtland, Ohio Geol. Surv., 1838, 162.

This is the common Oriole throughout the state, and is apparently on the increase in most sections. It is one of the first birds which the would-be bird student sees and hears, because it comes into the door-yard to nest, and sings fear-

lessly. Its pendant nest is a familiar sight on almost every street, after the leaves have fallen.

Its food consists largely of injurious insects, particularly caterpillars and the small plant and bark lice which are overlooked by most other birds. It is true that some ripe fruit is eaten, but so little, usually, that little harm is done. A mulberry tree will prove a safeguard from anything which the Baltimore Oriole might be inclined to do with other fruit, for he does love ripe mulberries.

This Oriole reaches our southern border early in the last week of April, and loses little time in crossing the state, passing south about September 5, in the northern, and the 10th in the southern counties. A few individuals may linger well toward October.

184. (509.) *SCOLECOPHAGUS CAROLINUS* (Müll.). 121.
Rusty Blackbird.

Synonyms: *Scolecophagus ferrugineus*, *Quicalus ferrugineus*,
Oriolus ferrugineus, *Turdus carolinus*.
Rusty Grackle, Thrush Blackbird.

Kirtland, Ohio Geol. Surv., 1838, 162.

The little known Rusty Blackbird is a regular migrant across the state both spring and autumn, usually fairly common but seldom, if ever, very prominent. In the southern counties it is a tolerably common winter resident. As a migrant it could do no harm if it would, except possibly to the ripe corn crop. There is no evidence that it is ever harmful.

It is among the earlier spring birds, arriving during the first week in March and remaining until the end of the first week in May, returning again about the middle of September and remaining well into November, in the north. There is one record for February 13, 1897, when a female was shot in the marshes on Lake Erie. It must have wintered there.

185. (511b.) *QUISCALUS QUISCULA ÆNEUS* (Ridgw.). 122.
Bronzed Grackle.

Synonyms: *Quiscalus purpureus* var. *æneus*, *Q. versicolor*, *Q. purpureus*, *Q. æneus*.

Crow Blackbird, Common Blackbird, Purple Grackle,
Bronzed Crow Blackbird, Brass Grackle, Western Crow
Blackbird.

Kirtland, Ohio Geol. Surv., 1838, 162, 180.

This is the common "Blackbird" of lawns and shade trees. Its steel-blue head and neck and bronze-colored body would at once distinguish it from the other blackbirds. Dr. Wheaton states that it is "Found everywhere, but is especially numerous in sycamore groves along streams, and in oak woodland." I am not aware that it is now found breeding away from the immediate vicinity of human habitations. It is particularly numerous at farm dwellings where Lombardy poplars are numerous, and in towns and parks among the evergreen trees. It also roosts in the shade trees in parks and along the streets where shade trees form a sufficiently thick growth.

There can be no question that this species does more good than harm the whole year through, but that is not saying that the birds should always be left to do as they choose. It is too true that during the fall, when the small grains are standing in shock and the corn is in the milk, the grackles do great damage, sometimes descending in immense flocks upon a field, filling themselves with the grain. They also eat ripe fruit to some extent. During the spring they are decidedly beneficial in ridding the newly turned soil of grubs and other insect larvæ. The farmer must be his own judge and execute his sentence—if he can.

The Bronzed Grackles reach northern Ohio during the first week in March, not seldom with the other first spring birds. At Oberlin the arrivals usually fly first to the trees in which the roost was selected the previous summer, and then station themselves about town to suit their own fancy. The bulk of individuals leave for the south about November 10, but stragglers remain into December, or rarely all winter long.

Family FRINGILLIDÆ. Finches, Sparrows, Buntings, etc.

Of this group there have been found in Ohio 33 species native to North America, and one imported species. Only one other family of birds exceeds this in number of species, and probably none exceeds it in the numbers of individual birds, for the sparrows are always numerous. These birds are also among the most puzzling to the average student. Their food habits are given under each species.

186. (514.) *HESPERIPHONA VESPERTINA* (Coop.). 84.
Evening Grosbeak.

Synonyms: *Coccothraustes vespertina*, *Fringilla vespertina*.
Kirtland, Ohio Farmer (newspaper), IX, 1860, 91.

Dr. Wheaton knew of but one record for this northern species, in the reference given above. A female was taken by Mr. Charles Pease, Jr., and several others were seen by Dr. Kirtland, a few days previous to March 24, 1860. There was a small flight southward during the latter part of January, 1890, when a specimen was secured by Dr. Carl Tuttle, of Berlin Heights, Erie county, January 30, 1890; a number were seen by Mr. A. Hall, of Cleveland, and by Rev. J. M. Keck, in Lake county. At best it is a rare winter visitor to northern Ohio.

187. (515.) *PINICOLA ENUCLEATOR LEUCURA* (Müll.). 85
Canadian Pine Grosbeak.

Synonyms: *Pinicola enucleator*, *Corythus enucleator*, *Pinicola canadensis*, *Loxia enucleator*.

Kirtland, Am. Journal Sci. and Arts, XIII, 1852, 218.

The records of the occurrence of this northern bird are few, and, except Audubon's inferential reference to specimens captured at the mouth of the Big Guyandotte, in West Virginia, are confined to northern Ohio. Dr. Wheaton gives three records, two besides Audubon's. Dr. Kirtland recorded it from near Cleveland, and the statement by Mr. Read that it is "rare, though occasionally seen during most of the year," seems to me a decidedly questionable

record. Possibly the Purple Finch was meant. The only other records that I have are one by Mr. A. Hall, of Cleveland, who captured a specimen, date not known, and one by myself in Lorain county, January 1, 1902. It seems likely that more activity in field work during the winter would result in other records of this interesting species.

188. (517.) *CARPODACUS PURPUREUS* (Gmel.). 86.
Purple Finch.

Synonyms: *Fringilla purpurea*.

Purple Grosbeak, Crimson Finch, Linnet.

Kirtland, Ohio Geol. Surv., 1838, 164, 184.

The Purple Finch is a regular, but hardly common, migrant, and less numerous winter resident in all parts of the state. With us it occurs in small flocks, frequently associated with Goldfinch. In Lorain county it is too irregular to make any definite statements about its appearance in spring or autumn worth anything. Singing individuals have been recorded after the middle of May, and as early as the first of September.

While in the state the food of this species is not such as to affect agricultural interests, if it ever does. I have seen it breaking off and scattering the buds from trees, working at the pine cones, and eating weed seeds from near the ground.

189. (521.) *LOXIA CURVIROSTRA MINOR* (Brehm.). 87.
American Crossbill.

Synonyms: *Loxia curvirostra* var. *americana*, *L. curvirostra*, *Curvirostra americana*, *Curvirostra minor*.

Common Crossbill, American Red Crossbill, Red Crossbill.

Kirtland, Ohio Geol. Surv., 1838, 164, 184.

This Crossbill is an irregular winter visitor, and possibly breeds occasionally. Its appearance and disappearance are unaccountable. It has appeared at Oberlin during early autumn and been common both in the village and surrounding region until the following June, and then disappeared completely for months or years. Considerable flights some-

times occur during the winter or early spring only, followed abruptly by total disappearance. It may be found anywhere in the state where coniferous trees furnish food. Mr. E. A. Doolittle informs me that flocks are present now (late June) at Painesville. I have found a flock at Oberlin during the last week in June, 1903.

I have never seen the birds feeding on anything but pine nuts which are taken from the cones either on the trees or as they lie on the ground.

190. (522.) *LOXIA LEUCOPTERA* Gmel. 88.
White-winged Crossbill.

Synonyms: *Curvirostra leucoptera*.

Wheaton, Ohio Agri. Report, 1860, 346, 366.

This Crossbill is rare in Ohio. There appear to have been three flights, of which we have records, which may have reached Ohio. One was in 1868-9, when Dr. Langdon found considerable numbers of them associated with the Red Crossbills in the proportion of two of the White-winged to one of the other, in the vicinity of Cincinnati. Another flight mentioned by Mr. A. W. Butler (*Birds of Indiana*, 921) occurred in 1883-4, when numerous Indiana records were made, but apparently no Ohio records have come to light for this flight. The third and last occurred during the winter of 1901-2, when a flock remained near Elyria, Lorain county, for at least two weeks early in January, 1902. Other records are scattering and probably do not have to do with large flights. At best the species is irregular, requiring unusual weather and food conditions to be forced south.

191. (528.) *ACANTHIS LINARIA* (Linn.). 89.
Redpoll.

Synonyms: *Ægiothus linaria*, *Fringilla linaria*.

Red-poll Linnet, Common Red-poll, Lesser Red-poll.

Kirtland, Ohio Geol. Surv., 1838, 164, 183.

The Redpoll is probably a little less rare than the last

species, but it has ceased to be the "Tolerably regular winter resident in northern Ohio" that Dr. Wheaton knew. During my ten years' residence in Oberlin I have never seen it, in spite of many winter days spent afield in search for it. The rare occasions when it does cross Lake Erie are notable ones, for then the birds are among the most numerous of winter birds. Stragglers may be found occasionally. One was taken by Mr. Charles Dury in January, 1869, at Cincinnati.

The Redpoll feeds much after the fashion of the Goldfinch, the flock taking possession of a weed and apparently cleaning out the seeds before leaving, twittering all the while. They are not wary and allow a close approach.

192. (529.) *ASTRAGALINUS TRISTIS* (Linn.). 90.
American Goldfinch.

Synonyms: *Chrysomitris tristis*, *Fringilla tristis*, *Carduelis tristis*, *Spinus tristis*.

Yellow-bird, Thistle-bird, Lettuce-bird, Salad-bird, Wild Canary.

Audubon, Orn. Biog., 1831, 172.

Goldfinch is one of our commoner birds the year through, but during the colder part of the year—from October to April—he is known as a common sparrow, by the majority of persons, because his bright yellow and deep black dress has given place to drab only tinted with yellow. He has lost his cheerful, rollicking song, also, substituting a conversational twitter while he feeds or flies. During the more inclement weather flocks of Goldfinches take refuge in the woods, where they feed upon such weed and grass seeds as may be found there in the more open places. At other times they range the fields for food. Goldfinches and Tree Sparrows are frequently found in flocks together, both in woods and open fields.

The winter food of Goldfinch consists largely of weed and grass seeds taken from standing weeds and grass. In summer and autumn thistle seeds are much in favor, as they are in winter if there are any left. Insects are

eaten and fed to the young during July and August, with some seeds after the young are able to digest such hard food. The great usefulness in destroying quantities of weed seeds cannot be questioned. If he ever does damage I have not heard of it.

193. (533.) *SPINUS PINUS* (Wils.). 91.
Pine Siskin.

Synonyms: *Chrysomitris pinus*, *Fringilla pinea*, *Linaria pinus*.
Pine Linnet, Pine Finch American Siskin.
Storer, Proc. Bost. Soc. Nat. Hist., II, 1845, 52.

The Pine Siskin has certainly decreased in numbers since Dr. Wheaton knew it in 1882, when he regarded it as abundant. It is reported as rare from the southern, and only locally common from the central portion of the state. In the northern counties, particularly those touching Lake Erie, it may frequently become common during the autumn and spring, less so during winter. There is no authentic record of its breeding in the state, unless Dr. Kirtland's circumstantial evidence of mating and presence in June and July, 1850, be so considered. He states that both old and young appeared for three successive years early in July. No nests were found.

I have never found the Pine Siskin before the first week in September nor later than the first week in May in Lorain county. It is not always present all winter, but may be. I have found it usually associated with Goldfinch feeding with them and like them, but occasionally in small flocks by themselves feeding in the pine and cedar trees and hemlocks.

194. (534.) *PASSERINA NIVALIS* (Linn.). 92.
Snowflake.

Synonyms: *Plectrophanes nivalis*, *Emberiza nivalis*, *Plectrophenax nivalis*.
Snow Bunting, Snowbird, White Snowbird.
Audubon, Orn. Biog., II, 1834, 515.

Snowflake seldom appears in northern Ohio before the

new year opens. It could hardly be called common, in the usual acceptance of that term, at any time, because the birds band themselves together in greater or lesser flocks and are not found in any other fashion. The flocks range over considerable territory, appearing and reappearing at any one place but few times during the winter. The flocks may range from a few to several hundred individuals. Rarely single birds may be found with the flocks of Horned Larks or Lapland Longspurs. The species is less and less numerous as one proceeds southward from the lake shore, becoming only occasional in southern Ohio, in exceptional weather.

Feeding wholly on the ground, Snowflake picks up such seeds as may have been dropped or missed by the other sparrows. When the ground is completely covered with snow they are driven to feed upon the standing weed tops which project above the snow. A favorite feeding-place is a railroad track, where grains of wheat and oats sift through the cars and afford easy picking.

The Snowflakes are strictly winter birds, seldom appearing before the country is well snow-bound, or they drive down just in front of a blizzard to give fair warning. They are gone before April, usually not long after the first of March.

195. (536.) *CALCARIUS LAPPONICUS* (Linn.). 93.
Lapland Longspur.

Synonyms: *Plectrophanes lapponicus*, *Centrophanes lapponicus*, *Fringilla lapponica*.

Wheaton, Ohio Agri. Report, 1860, 366.

Dr. Wheaton's statements regarding this winter species still hold good for practically all of the state, except that I would not term it common at any time. "The first to appear are single birds, in company with Shore Larks. Afterward they may be seen in compact flocks of from ten to thirty, frequenting old brick-yards, and fields where cattle are fed, in company with Shore Larks, with which they associate on the ground, but fly by themselves in close flocks.

Frequently when first flushed they utter a rapid rattling note." To this we can fully agree.

The first severe winter weather marks their appearance, which is about the first of December, in the vicinity of Oberlin. I have seen flocks as late as April 23.

The food is chiefly weed and grass seed and grain, with a little insect food intermingled, even in winter. The birds are strictly beneficial.

196. (540.) *POECETES GRAMINEUS* (Gmel.). 95.
Vesper Sparrow.

Synonyms: *Pœcætes gramineus*, *Fringilla graminea*.

Bay-winged Bunting, Grass Finch, Gray-bird, Vesper-bird, Ground-bird.

Kirtland, Ohio Geol. Surv., 1838, 164.

This is our common "Ground Sparrow" so called. It does not disdain a perch on a fence, nor even a tree, but is more often found skulking or running on the ground in the grass. The first part of its song is a weak imitation of Meadowlark's usual song. The bird may be readily recognized by its two white outer tail feathers.

The food of the Vesper Sparrow varies with the season. While it remains in the state it eats more insects than vegetable matter, but during the winter it eats seeds and grain almost exclusively. During the warmer part of the summer its diet is 90 per cent. insect. A large part of the grain eaten is undoubtedly gleaned from the stubble, and would be wasted if the sparrow did not find it, or spring up in next year's cornfield only to make trouble. The good done in the destruction of injurious insects is greater than that of any other sparrow. Add to this the weed seeds destroyed during the autumn and you have a strong case for this sparrow.

Vesper Sparrow reaches Oberlin during the last week in March, and is common on the day of arrival, singing lustily. In a few days the numbers have greatly increased until almost every other bird seen is of this species. They literally swarm over the fields and pastures. As the migrations progress the numbers are reduced somewhat, but all

summer long it is an abundant species. The bulk of individuals has gone south by the first of October, but scattering individuals may remain well into November.

197. (542a.) *PASSERCULUS SANDWICHENSIS SAVANNA*
(Wils.). 94.

Savanna Sparrow.

Synonyms: *Passerculus savanna*, *Ammodramus sandwichensis savanna*, *Fringilla savanna*.

Common Savanna Sparrow.

Wheaton, Ohio Agri. Report, 1860, 366.

Judging from the reports that have come to me, this is not a common species, certainly not "Very common," as Dr. Wheaton found it. The apparent rarity may well be due to unfamiliarity. I have not found it even common in Lorain county; a half-dozen records for the season is unusually good success. I have utterly failed to find this bird in summer. Rev. Mr. Henninger reports it as common during the migrations, but a rare breeder in southern Ohio (Scioto and Pike counties). In the nature of the case, it must be of local distribution. It is a great skulker in the grass and may easily escape notice.

This, with other sparrows of the genus, prefers insects to seeds and grain, while they are with us. This sparrow in particular is the greatest of all beetle-eaters. Weevils and other destructive species form a large part of its diet during June, July, and August. The seeds eaten are weed seeds that we are anxious to get rid of, and the grain is almost wholly waste, since these birds do not go in flocks, but skulk about rather than expose themselves to view.

The Savanna Sparrow appears in southern Ohio during the first week in April, and has reached our northern counties a week later (March 21, 1903). It leaves us about the last week in October.

198. (546.) *COTURNICULUS SAVANNARUM PASSERINUS*
(Wils.). 96.

Grasshopper Sparrow.

Synonyms: *Coturniculus passerinus*, *Ammodramus savannarum passerinus*, *Fringilla passerina*.

Yellow-winged Sparrow, Quail Sparrow, Cricket Sparrow.

Kirtland, Ohio Geol. Surv., 1838, 164.

This little sparrow is local in its distribution, but may be fairly common in suitable regions, over the entire state. Its diminutive size and weak voice serve to hide it from all but the unusually interested. It seldom essays a higher perch than the top of a fence-post, and is usually content with a weed stalk or bunch of grass. It nests on the ground in meadows or neglected fields.

The food consists of insects and weed seeds and grain, but almost half of the whole food consists of injurious insects, and the grain is waste. The seeds are wholly of injurious weeds and grasses. As a destroyer of injurious insects this sparrow leads all the sparrows and equals some of the larger birds, like the Robin, which are supposed to feed largely upon insects and worms.

It appears in Ohio during the last week in April and remains until the first of October. During this time it must be looked for on the uplands, not in low places.

199. (547.) *AMMODRAMUS HENSLOWII* (Aud.). 97.

Henslow Sparrow.

Synonyms: *Coturniculus henslovii*, *C. henslowi*, *Emberiza henslovii*.

Henslow's Bunting, Henslow's Grasshopper Sparrow.

Jones, Auk, XII, 1895, 241.

Dr. Wheaton gives it in his catalogue of 1882, citing references to Audubon, Birds Am., III, 1841, 76, and his own publications based upon Audubon's statement and upon a supposed specimen which Dr. Wheaton collected in the vicinity of Columbus in 1856, which proved to be the young of *A. s. passerinus*. Dr. Wheaton eliminates these records and says, "In all probability Henslow's Bunting will be found not uncommon in restricted localities, particularly in the

southern and western portions of the state." It seems, therefore, that the reference given above should stand as the first published record for the state. During the entire summer of 1894 this sparrow was found in considerable numbers about Oberlin, and several specimens were taken. I have looked for it in vain every year since then. There are no other reports of its occurrence within the state.

200. (549.1.) *AMMODRAMUS NELSONI* (Allen). —.
Nelson Sparrow.

Synonyms: *Ammodramus caudacutus nelsoni*.
Nelson's Sharp-tailed Sparrow.

To Mr. Robt. J. Sim, of Jefferson, belongs the honor of adding this interesting bird to our state list. The bird was captured in the vicinity of Geneva, Ashtabula county, on May 17, 1902, and sent to me for identification. It proved to be a fine specimen in full spring dress. When captured the bird was on a bit of high, almost barren ground which lies between two arms of the extensive marsh near the lake shore. It seems probable that this secretive bird may be found sparingly throughout the state in suitable places.

201. (552.) *CHONDESTES GRAMMACUS* (Say). 98.
Lark Sparrow.

Synonyms: *Chondestes grammaca*, *Fringilla grammaca*.
Lark Finch.

Wheaton, Field Notes, I, 1861, 129.

The appearance and spread of this, one of the most beautiful singers among the sparrows, is very interesting. Dr. Wheaton records the first ones seen in 1861. In 1882 it had spread well over the southern half of the state, at least as far as the Scioto river, but was not known north of the central portion. In 1890, when I came to Oberlin, it was not known in Lorain county, but two years later Mr. L. M. McCormick found it on the Vermilion river bottoms. Since that time it has been found regularly, but in small numbers in the western half of the county, and has also reached

Cleveland. Mr. I. A. Field has found it not uncommon at Granville and at Licking reservoir. It has not been reported from the eastern third of the state, but may be found there within a few years.

This is one of the great grasshopper-eating sparrows. During its stay it eats almost no grain, but does eat grass, clover and weed seeds, and numbers of weevils, besides the grasshoppers. It is therefore deserving of protection, and should never be persecuted.

It does not reach Ohio before the first of May, and is gone again early in September. It must be looked for in fields bordering woods, where it nests on the ground.

202. (554.) ZONOTRICHIA LEUCOPHRYS (Forst.). 99.
White-crowned Sparrow.

Synonyms: *Fringilla leucophrys*, *Emberiza leucophrys*.

White-browed Sparrow, White-browed Crowned Sparrow,
White-crowned Bunting.

Audubon, Orn. Biog., II, 1834, 88.

There is little danger of confusing this with the next species in the spring, but far more in the autumn when the black head stripes of spring have given place to brown, and the white is reduced to gray. A little careful attention will discover the difference between them at any time.

In Lorain county we look for the White-crowns in the brush fringing woods. Sometimes the White-throats may invade their favorite places, but I have never found them invading the thickets which the White-throats regard their own. This species is strictly migratory, and has never been known to breed in Ohio, although Dr. Kirtland recorded them in July, 1850, near Cleveland.

While with us the food consists of vegetable matter three-fourths to the animal matter one-fourth. Of the vegetable matter but a small proportion is grain, and a good proportion of that is probably waste. Some fruit is eaten during the summer, but none during the southward journey, or so little as to amount to nothing. The animal food is about a third caterpillars, the rest being ants, wasps, beetles and

but few grasshoppers. It would thus appear that this sparrow is deserving of protection for the large numbers of weed seeds destroyed, and for its part in keeping in check the insect pests.

The White-crowned Sparrow reaches Ohio during the first five days of May and remains nearly two weeks. It returns again early in October and remains about two weeks.

203. (558.) *ZONOTRICHIA ALBICOLLIS* (Gmel.). 100.
White-throated Sparrow.

Synonyms: *Fringilla pennsylvanica*, *F. albicollis*.

White-throated Crown Sparrow, Peabody-bird, White-throat,
Yellow-browed Sparrow, Bush Sparrow.

Kirtland, Ohio Geol. Surv., 1838, 164, 183.

If the White-crowned Sparrow be considered common during its migrations the White-throat is abundant usually. There is no direct evidence that it ever breeds in the state. It prefers the brushy tangles bordering woods, but may be found in almost any brushy places away from woods, particularly if it be abundant. It associates with Song, Field and Vesper Sparrows more or less, and with Juncos sometimes. The clear, whistled call or song may rarely be heard during the southward movement, but is given full-voiced during the northward one. To one familiar with the bird its alarm call is characteristic.

Weed seeds comprise half of what this sparrow eats, only 3 per cent. is grain; about 30 per cent. is wild fruit in the season of fruit. The insects eaten are chiefly harmful species. The debt is therefore wholly on our side of the account.

The White-throat reaches northern Ohio from its winter sojourn in the southern counties, early in April and remains well into May. It returns again late in September and remains about five weeks.

204. (559.) *SPIZELLA MONTICOLA* (Gmel.). 101.
Tree Sparrow.

Synonyms: *Spizella montana*, *Fringilla canadensis*, *F. monticola*.

Winter Chippy, Winter Chip-bird, American Tree Sparrow, Canadian Sparrow.

Kirtland, Ohio Geol. Surv., 1838, 164.

Tree Sparrow is by far our most abundant winter bird. It ranges both woods and fields, cleaning up every weed patch in the country. It lives in flocks of from ten or a dozen to several hundred individuals, and not infrequently sings in the dead of winter. One could not watch a flock of these birds for five minutes and retain a fit of the "blues." In the coldest and stormiest weather they find something to be happy about.

These birds seem to have a preference for grass seed, and will clean up anything that may be left exposed. But surely no thrifty farmer will leave his millet or timothy shocks out all winter long. In the absence of cultivated grasses great quantities of injurious grass seeds are destroyed. Only two per cent. of animal matter is eaten, hence the service of these birds lies in the weed seeds destroyed.

They reach Ohio about the beginning of the second week in October and remain until the middle of April, or sometimes even into the last week of April.

205. (560.) *SPIZELLA SOCIALIS* (Wils.). 102.
Chipping Sparrow.

Synonyms: *Spizella domestica*, *Fringilla socialis*.

Chippy, Chip-bird, Hair-bird, Chipping-bird, Chipper.

Kirtland, Ohio Geol. Surv., 1838, 164.

This sociable little bird is one of the door-yard birds which must be well known to all who take any interest in their feathered visitors. He may nest in the vine which covers the trellis, if not disturbed; or at least in one of the ornamental trees in your yard, or in the grape-vine. Some have supposed that this and the Tree Sparrow were the same, but this sparrow goes south in winter. It is really

abundant during the entire summer throughout the state:

The food consists of 62 per cent. vegetable to 38 animal matter. Only 4 per cent. of the food is grain, and there seems to be no evidence that any fruit is eaten. Of the 38 per cent. of animal food a large part consists of the caterpillars of some of our most injurious insects. In large part these are such insects as other birds do not find because they are afraid to come so near human habitations. Although not larger than your thumb, this little bird is among the most useful of our sparrows.

It may be a resident in the southern counties, unless the weather is too severe. In northern Ohio it appears close to the first of April, but does not become common before the last of the month. The last ones leave the lake shore about the middle of October.

206. (563.) *SPIZELLA PUSILLA* (Wils.). 103.

Field Sparrow.

Synonyms: *Fringilla pusilla*, *F. junco*, *Spizella agrestis*.

Wood Sparrow, Bush Sparrow, Field Chippy, Red-billed Chippy, *Feo-feo*.

Kirtland, Ohio Geol. Surv., 1838, 164.

The Field Sparrow is really a bush-haunting sparrow, and is not infrequently called the brush sparrow. The brush fringing woods is the favorite haunt of this species. Brushy pastures are usually full of them and their nests. Their peculiar *accelerando* song is characteristic of such places.

The food habits and food are very similar to those of Chipping Sparrow. Both deserve strict protection.

The Field Sparrow spends the entire winter south of Ohio, and returns during the third week in March, rarely earlier. It remains well into October, and may linger until November in the extreme southern part of the state.

207. (567.) *JUNCO HYEMALIS* (Linn.). 104.
Slate-colored Junco.

Synonyms: *Fringilla hyemalis*.

Snowbird, Eastern Snowbird, Black Snowbird, Common Snowbird, Junco, White-bill.

Kirtland, Ohio Geol. Surv., 1838, 164, 183.

This "Snowbird" is a winter resident over the whole state, but is not usually common during January and February in the extreme north. When it is present during these months it is pretty closely confined to the deeper stream gorges, where it finds food, and protection from the cold winds. In the central and southern parts of the state it may be found with the flocks of Tree Sparrows and Goldfinches, well scattered over the country. There it may pass the night in the corn shocks.

During the winter Junco eats weed and grass seeds almost exclusively, only nine per cent. of its entire food being animal. There is so little grain eaten that it does not figure. Hence the Junco is a great aid to the agricultural interests in the destruction of weeds.

Junco appears in northern Ohio about the first of October and within a week has made his way to our southern border. He leaves that border about the middle of April, often later, but tarries along the lake shore until the first of May.

208. (575a.) *PEUCEA ÆSTIVALIS BACHMANII* (Aud.). —
Bachman Sparrow.

Synonyms: *Fringilla bachmanii*.

Oak-woods Sparrow.

Henninger, Bulletin Michigan Orn. Club, II, 1898, 7.

The first specimen was captured by C. M. Weed, August 18, 1890, at Columbus. The specimens reported by Rev. Mr. Henninger in the above reference were taken on April 23, and a second observed on May 3, 1897, at South Webster. Miss Laura Gano reports several on April 27, and later, on Grosbeck Hill, Avondale, and College Hill, Cincinnati. Leander S. Keyser sends a questionable record for Clarke county. The invasion has been from the south-

west, with an apparent intention of remaining to possess the state. Let us hope so.

209. (581.) MELOSPIZA CINEREA MELODIA (Wils.). 105.
Song Sparrow.

Synonyms: *Melospiza fasciata*, *M. melodia*, *Fringilla melodia*,
F. fasciata.

Silver-tongue.

Kirtland, Ohio Geol. Surv., 1838, 164.

Next to the Chipping Sparrow, this is probably our best known sparrow (always omitting mention of Britain's constant representative). It is present during the entire year in all parts of the state, but, unlike Junco, is far less common in the northern third in winter than elsewhere, and far less than it is during the summer. In summer it lives in the brushy tangles bordering woods and swamps, or the fields where weeds are allowed to grow, or even the back yards in the more thinly settled parts of towns and villages. In winter it loves brush piles in the woods, provided there is a good supply of food at hand. It is also found in some numbers in the thick tangle of grass and sedges bordering the swamps and bogs. It begins to sing early in February if there be bright days. The early spring songs differ from the later ones.

Only six per cent. of the food of this sparrow could possibly be of any use to man, while the weeds and injurious insects destroyed are something enormous in quantity when the abundance of the species is considered. It is true that its increasing familiarity tends to develop in it a taste for ripe fruits and more grain, but the useful things destroyed are so completely overbalanced by the good it does that we can afford to freely forgive and forget.

The great increase in the numbers of this sparrow in Lorain county occurs about the first of April; then large numbers arrive from the south and swell the numbers already here.

210. (583.) *MELOSPIZA LINCOLNII* (Aud.). 107.
Lincoln Sparrow.

Synonyms: *Fringilla lincolnii*.

Lincoln's Finch, Lincoln's Song Sparrow.

Wheaton, Ohio Agri. Report, 1874, 566.

Little seems to be known of this sparrow. Its close resemblance to Song Sparrow probably causes it to be confused with that species. It is nowhere common in the state, even during the height of the migrations. It does not breed with us, but passes north. I have usually found it in low brushy woods, rarely in the fields bordering woods. It skulks about in the grass and weeds more than the Song Sparrow, and has a very different song. One would not confuse the two a second time. Rev. Mr. Henninger regards it as common during the migrations in Scioto county.

It arrives in southern Ohio early in April, but Lorain county records all fall in May. It is not unlikely that the birds passing up the Scioto river are earlier than those which travel overland to reach Lorain county. The birds stay but a few days and pass north. In the autumn they return late in September or early in October.

211. (584.) *MELOSPIZA GEORGIANA* (Lath.). 106.
Swamp Sparrow.

Synonyms: *Melospiza palustris*, *Fringilla palustris*, *F. georgiana*.

Swamp Song Sparrow, Spotted Swamp Sparrow.

Kirtland, Ohio Geol. Surv., 1838, 164.

The Swamp Sparrow is so much confused with the Song and other brush-haunting sparrows that it is difficult to determine its exact standing. Judging from the reports it is not common during the migrations. It is reported as breeding near Circleville, by Dr. Howard Jones, who found a nest in May, 1881, which contained five eggs. The bird was shot.* I have looked for it in vain from Cleveland to Sandusky on the lake shore, in summer. My own experience with it would indicate that it is fairly common during

*Illustrations of the Nests and Eggs of Ohio Birds, p. 186.

the spring migrations in Lorain county. It frequents rather wet woods which are much grown with brush, as well as the more swampy places.

In food habits this sparrow is not injurious, but its preference for swampy places, where it feeds upon the insects and seeds, does not give it a high standing as a beneficial species. However, it must be classed as one of the sparrows which does more good than harm.

This sparrow reaches Lorain county about April 21, and remains until about the middle of May, returning again late in September for ten days or two weeks.

212. (585.) *PASSERELLA ILIACA* (Merr.). 108.

Fox Sparrow.

Synonyms: *Fringilla iliaca*.

Eastern Fox Sparrow, Fox-colored Sparrow, Rufous Sparrow.

Kirtland, Ohio Geol. Surv., 1838, 164.

This is a common migrant both spring and autumn. It is found in the brushy woods in company with the other sparrows which haunt such places, but it seems to feel an aloofness to them. It is rather slow and sedate in carriage, not skulking in the brush piles as much as the others.

Fox Sparrow is fond of millipeds in April, and eats many ground beetles during that month also. Of the 86 per cent. of vegetable matter which constitutes its food, some 30 per cent. consists of the seeds of fruit. The remaining vegetable matter is largely seeds of ragweeds and polygonum. While some of the insects are useful, and possibly some of the fruit is cultivated, the destruction of weed seeds is so large that the birds perform a great service to agriculture.

This is one of the early spring sparrows, arriving at Oberlin about the middle of March and remaining five weeks. It returns again during the last week in September, or the first week in October, and remains a month.

213. (587.) *PIPILO ERYTHROPHthalmus* (Linn.). 109.
Towhee.

Synonyms: *Fringilla erythrophthalma*.

Towhee Bunting, Chewink, Ground Robin, Marsh Robin, Red-eyed Towhee, Jewee, Joree, Pink-pink, Wink, Wink-wink, Pipilo, Turkey Sparrow.

Kirtland, Ohio Geol. Surv., 1838, 164.

Towhee is a resident over most of the state, but in small numbers north. It is likely that the resident birds are males while the females are more migratory. In northern Ohio the winter birds must be looked for in well protected places where food is easily obtainable. During the summer the Towhee may be found in almost any thicket bordered woods, or in the lower brushy second growth. I have found nests in the higher, more open woods, as well as in the brushy tangles. No one who visits the woods can have failed to make the acquaintance of this strong-voiced bird.

The food habits do not seem to have been carefully investigated, but from the structure and general habits one might infer that this rather unsparrow-like sparrow feeds more after the fashion of the Robin. Such insects as haunt the ground are eaten in considerable quantities, as well as the weed seeds that may be found in the woods. It is certainly true that Towhee is useful as a weed destroyer.

The migrating females reach southern Ohio about the middle of April and depart about the middle of November. The migrating males reach Oberlin about the middle of March, and but few remain after the first of November.

214. (593.) *CARDINALIS CARDINALIS* (Linn.). 110.
Cardinal.

Synonyms: *Cardinalis virginianus*, *Fringilla cardinalis*, *Pitylus cardinalis*, *Loxia cardinalis*.

Cardinal Redbird, Crested Redbird, Top-knot, Redbird.

Audubon, Orn. Biog., II, 1834, 366.

Cardinal is now a common resident over the entire state. Ten years ago it was scarce in Lorain county, and even now is far less numerous at the lake shore than twenty miles

south. Lately it has appeared at London, Ontario. Clearly it is extending its range from year to year. With more thorough protection it will soon become one of our most familiar birds.

This large, strong beaked bird is made for a diet of seeds which most other sparrows could not crush. I sometimes wonder what the birds which apparently spend all their time in towns and villages find to eat there. But there are always gardens with more weeds than vegetables. Weed seeds must form a large proportion of its food, with a small proportion of insects and fruit. I have yet to hear complaints about the destructiveness of this brilliant plumaged bird. Its loud, clear whistled calls and song are familiar to most persons, whether they go into the woods or not.

Away from towns and villages the birds are thicket haunters. They are often more numerous along the courses of streams than elsewhere, especially during the winter.

215. (595.) *ZAMELODIA LUDOVICIANA* (Linn.). 111.

Rose-breasted Grosbeak.

Synonyms: *Goniaphea ludoviciana*, *Fringilla ludoviciana*, *Coccothraustes ludoviciana*, *Guiraca ludoviciana*, *Hedymeles ludoviciana*, *Habia ludoviciana*.

Rose-breasted Song Grosbeak, Rose-breast, Redbreast, Red-breasted Song Grosbeak, Red-breasted Grosbeak, Potato-bug Bird.

Audubon, Orn. Biog. II, 1834, 166.

The Rose-breasted Grosbeak is hardly common as a migrant in the southern half of the state. It is a summer resident in the northern half, but is rare as far south as Columbus, and not common at the lake shore. It is not infrequently seen among the shade trees bordering village streets, and may nest in the parks if not persecuted. Its favorite nesting-place is a woods in which there are patches of second growth or large bushes. Briar patches and brushy tangles do not seem to offer many inducements.

The "gross" beak is adapted for crushing strong seeds, upon which it feeds to a large extent. It is also accused of eating ripe fruit. I have seen it eating the buds from

trees. The birds are not numerous enough to be of much use or harm, but they are certainly more useful than harmful.

These grosbeaks reach Oberlin close to the first of May and remain until the middle of September.

216. (598.) *CYANOSPIZA CYANEA* (Linn.). 112.

Indigo Bunting.

Synonyms: *Passerina cærulea*, *Passerina cyanea*, *Fringilla cyanea*, *Tanagra cyanea*.

Indigobird, Indigo Painted Finch, Indigo Painted Bunting, Indigo Bluebird, Blue Linnet, Green Linnet, Indigo, Green Bird, Blue Nonpareil.

Kirtland, Ohio Geol. Surv., 1838, 164, 183.

The Indigobird is a common summer bird over the entire state, being almost abundant in some places. It is fond of any sort of thicket, from the brush fringing woods and weedy briar tangles to the rank vegetation bordering streams, marshes, and ponds, where it breeds.

Its food is similar to that of the Field Sparrow, with which it lives in perfect harmony. It is therefore one of the more useful of sparrows, of great service to agriculture because it is so numerous.

It reaches the state about the first of May and stays until October.

217. (604.) *SPIZA AMERICANA* (Gmel.). 113.

Dickcissel.

Synonyms: *Euspiza americana*, *Fringilla americana*, *Emberiza americana*.

Black-throated Bunting, Little Meadowlark, Little Field Lark, Judas Bird, Judas Iscariot.

Kirtland, Ohio Geol. Surv., 1838, 164, 183.

Dr. Wheaton's statement that this species is an "Abundant summer resident from May to September, in Middle and Southern, less common in Northern Ohio," hardly applies now. It is fairly common, and locally abundant, east to Licking county, and north to Columbus, but is rare north to Cleveland, and seems to be wholly unknown east of Cleveland. It is more numerous in the northwestern part

of the state than east of Toledo. It is a summer resident wherever it occurs, living and nesting in the fields much after the manner of the Meadowlark.

Unlike most of the sparrows, Dickcissel eats more than twice as much animal matter as vegetable matter. Of the vegetable matter only three per cent. is grain, the rest being weed seeds. Of the animal matter fully half of all food eaten is grasshoppers and crickets. A small percentage of useful insects is eaten, but it is so small a proportion that no account of them need be taken. This is, therefore, one of our most useful summer sparrows.

Rev. Mr. Henninger states that it is a rare summer resident in both Pike and Scioto counties where it has been unknown until within the last six years.

Family TANAGRIDÆ. Tanagers.

Only one of the two members of this family found in Ohio is distributed over the entire state. Both have brilliant plumage, and both are fairly good singers. While they are woods-haunting birds, the Scarlet Tanager frequently nests in parks and shade trees in cities and towns.

218. (608.) *PIRANGA ERYTHROMELAS* Vieill. 82.

Scarlet Tanager.

Synonyms: *Pyranga rubra*, *Tanagra rubra*, *P. erythromelas*.

Black-winged Redbird, Pocket-bird, Scarlet Sparrow, Canada Tanager, Red Tanager, Scarlet Black-winged Tanager.

Kirtland, Ohio Geol. Surv., 1838, 164.

In spite of his brilliant dress, and in spite of the fact that he is one of our common birds in every part of the state, there are many persons who do not know the Scarlet Tanager. When chance throws him so directly in their path that they must see him, he is heralded as the rarest of birds dropped down from —Limbo! How many there are who, having eyes, see not! There is no part of the state where this is not a common summer resident. It sometimes nests in our city and village parks, well up among the branches.

This bird destroys insects, weed seeds, and eats wild

fruit. I have seen it cutting the tender buds from elm trees and eating them. It is not injurious in any way, and is of considerable service to the farmer.

The Scarlet Tanager reaches Ohio about the first of May, frequently earlier, and returns to the south late in September.

219. (610.) *PIRANGA RUBRA* (Linn.). 83.
Summer Tanager.

Synonyms: *Pyranga æstiva*, *Tanagra æstiva*, *Fringilla rubra*.

Summer Redbird, Rose Tanager, Red Bee-bird, Flaxbird,
Redbird, Mississippi Tanager, Variegated Tanager.

Audubon, Orn. Biog., I, 1831, 232.

The distribution of this southern species in our state is rather remarkable. It is found in Trumbull, Portage and Columbiana counties in the east, but does not go beyond Franklin in the center nor Montgomery in the west, except casually. It thus appears to remain close to the Ohio river or its main tributaries. Its northeast range appears to be due to a recent movement, since Dr. Wheaton says nothing about it. There is no direct evidence, except the northeast movement, that its range is being much extended. No doubt there will be records of individuals from further north, as our activity in field work increases, but any considerable extension of its range in the next half century does not seem likely.

The deep ravines and gorges of the southeastern and southern parts of the state seem to be the favorite abiding places of this not very brilliant tanager. During a boating trip down the Muskingum and Ohio rivers, from Zanesville to Ironton, with my friend and fellow bird student, Rev. William Leon Dawson, during August of 1902, we found these birds at almost every stop below Marietta. They are not uncommon about McConnellsville, where Messrs. C. H. Morris and E. J. Arrick have found them nesting, but we were not fortunate in finding them during our stay there. Mr. Arrick well described the peculiar call note, which was often heard along the Ohio river, by the

syllables, *cluckity chuckity chuck*, or *chuckity tuckity tuck*.

This tanager's food is like that of the Scarlet Tanager—insects, varied by frequent helps of weed seeds and wild fruits in their season. It is distinctly useful.

It seems to slightly precede the Scarlet Tanager in its arrival, appearing during the last week in April and tarrying well into September.

Family HIRUNDINIDÆ. Swallows and Martins.

Five swallows and one martin spend the summer in Ohio. These birds pass most of their days on the wing feeding and playing. The martins are less active on the wing, but are good flycatchers nevertheless. All of this family not only rival but exceed the true Flycatchers as destroyers of flying insects, usually feeding upon the insects which fly higher or in the more open fields. Some glean from the top of the grass as they fly. A large colony of swallows under the eaves of a stock barn is the best friend of the milkman.

220. (611.) PROGNE SUBIS (Linn.). 76.

Purple Martin.

Synonyms: *Hirundo purpurea*, *H. subis*, *Progne purpurea*.

Martin, Purple Swallow, Black Martin, Black Swallow, Great American Martin, Blackbird Swallow.

Kirtland, Ohio Geol. Surv., 1838, 162.

Dr. Wheaton reported this as an "Abundant summer resident." If abundant anywhere now it is not so reported. There may still be a few colonies where large numbers of individuals breed. I have seen more at Lewiston reservoir, where we found them nesting in the stumps projecting above the water, than elsewhere. But even here they were not abundant. It seems clear that twenty years have served to greatly diminish their numbers over the entire state. What the cause of this decrease may be is hard to determine. Many have declared that since both Martins and English Sparrows use the bird-houses, and since the sparrows are on hand all winter, the Martins find their homes preëmpted when they return, and are unable to regain possession. If,

as we are told by Dr. W. B. Barrows in his report upon the English Sparrow, the sparrows are successful in driving the Martins away only half of the time, that would fully account for the decrease in numbers. There can be little question that at least a part of the decrease must be attributed to the sparrow.

It should not be necessary to state that the food of the Purple Martin consists largely of flying insects. During the time the young are fed the old birds are driven to search the ground as well as the air for grasshoppers and other large insects to appease the appetite of the always hungry young ones. Their services to mankind will only be appreciated when they are gone and nothing takes their place as destroyers of the insects which cause us so great annoyance.

The Martin not infrequently reaches our southern border during the second week in March, and the lake shore during the third week. It moves south again about September 15. Rev. Mr. Henninger reports an albino at South Webster, Scioto county, March 29, 1895.

221. (612.) PETROCHELIDON LUNIFRONS (Say.). 77.
Cliff Swallow.

Synonyms: *Hirundo fulva*, *H. lunifrons*.

Eave Swallow, Crescent Swallow, Mud Swallow, Mud Dauber, Square-tailed Barn Swallow, White-fronted Swallow, Rocky Mountain Swallow, Republican.

Bonaparte, I, 1825, 65.

The Cliff Swallow nests in colonies, and is therefore common and may be abundant in a few places. It is hardly common in Lorain county. There is no record of a colony nesting away from human habitations in Ohio since its settlement by civilized people. Their favorite nesting-place is under the eaves of a barn or other similar building, often in companies of several hundred, where the building affords enough room. The flask-shaped mud nests are familiar to every farm boy.

Like the other swallows, the Cliff Swallow feeds upon

the insects that fly a good deal, catching them in mid-air. These swallows are much liked by intelligent stock farmers and dairymen, for they keep in check the flies that annoy the herds and milch cows.

The Cliff Swallow appears at Oberlin during the last week in April. It leaves its nesting-places early in July and is gone south by the last of September.

222. (613.) *HIRUNDO ERYTHROGASTER* Bodd. 78.

Barn Swallow.

Synonyms: *Hirundo rufa*, *H. horreorum*, *H. erythrogaster* var. *horreorum*, *Chelidon erythrogastra*.

Fork-tailed Barn Swallow, American Barn Swallow, House Swallow.

Kirtland, Ohio Geol. Surv., 1838, 162.

This is the most common and familiar of our swallows, always remembering that the Chimney Swift is not a swallow. While it is not in such great numbers as the Vesper Sparrow, it may be fairly called abundant in practically all parts of the state as a summer resident. It nests in barns or almost any large out-building, or unused house; or under bridges. There is no record of the nests of this species under cliffs or in caves, as its habit was before civilized man appeared in America. In Oberlin the Barn Swallow is a familiar bird, nesting in any barn that may be left open for it. One may see them flying about the streets catching insects at any time of day, during the summer.

This swallow frequently gleans from the grass tops, as it skims along without apparent effort. House flies are also eaten, as well as the species of dancing flies which annoy the wheelman.

The appearance of Barn Swallows in spring largely depends upon the weather. They are such strong fliers that they may venture north for a single day early in March, during one of the spring-like days which are pretty sure to come, or they may tarry south until early April. The most have gone south by the first of September, but individuals usually remain until the last week in September.

223. (614.) *IRIDOPROCNE BICOLOR* (Vieill.). 79.
Tree Swallow.

Synonyms: *Hirundo bicolor*, *Tachycineta bicolor*.

White-bellied Swallow, Blue-backed Swallow, Field Swallow,
River Swallow, Wood Swallow, Green-blue Swallow,
Black-and-white Swallow.

Kirtland, Ohio Geol. Surv., 1838, 162.

Dr. Wheaton reported this as a "Very common summer resident." The only place where I have found it abundant was at Lewiston reservoir in July, where the birds swarmed about the multitudes of stumps in which they nested. Not even the English Sparrow ventured to disturb them there. In late July and early August the Tree Swallows roost in our northern marshes at night, or line the telegraph wires which pass such localities. They are abundant enough then, but where they have come from is a mystery. Certainly not from the immediate region, for they are not found except in small numbers during the summer. A few are willing to occupy the bird boxes erected for them and the Martins and Bluebirds, but most of them prefer to cling to their primitive habits of nesting in hollow trees.

The food differs from that of the other members of this group only in the difference in insects which naturally inhabit such regions as these swallows frequent a part of the year. During the weeks when the swallows are collecting for their southward journey they roost together in mixed companies of the several species, but one species usually predominates.

The Tree Swallows arrive and depart with the Cliff Swallows.

224. (616.) *CLIVICOLA RIPARIA* (Linn.). 80.
Bank Swallow.

Synonyms: *Cotyle riparia*, *Hirundo riparia*, *Riparia riparia*.
Sand Martin, Sand Swallow.

Kirtland, Ohio Geol. Surv., 1838, 162.

The Bank Swallow shifts its breeding-places to suit local conditions and therefore may be reported as common at one

locality for a term of years and afterward wholly absent. The banks in which it burrows to rear its brood are constantly changing, sometimes wholly disappearing. Railroad cuts furnish suitable places for a short time, and then become unfitted by the caving of the perpendicular banks to form a sloping bank. River banks and the clay banks facing Lake Erie are not alike two years in succession. Where a colony of some 200 pairs of the Bank Swallow nested for three years not one is to be found now. The bank caved off back of the nests twice in succession during the same spring, both times after many nests had been finished and the eggs deposited. That was too much for the swallows. Now there is but one large colony in Lorain county on the lake shore, but there are several small colonies. At the lake shore the birds might justly be called decidedly common, but elsewhere in the county they are scarce. Before the spread of the English Sparrows into the country hamlets Bank Swallows nested in the shale cliffs on Vermilion river, but now the sparrows occupy all of the available nesting-places.

With the restriction that this swallow may be found where cliffs or banks afford nesting-places, and not over the country generally, it may be called common over the entire state, during the summer. It is, of course, locally common.

Bank Swallow reaches the lake shore about the beginning of the last week in April, leaves its nesting-places early in July, and has gone south by the middle of September.

225. (617.) *STELGIDOPTERYX SERRIPENNIS* (Aud.). 81.
Rough-winged Swallow.

Synonyms: *Cotyle serripennis*, *Hirundo serripennis*.

"Bank Swallow," Rough-wing.

Kirkpatrick, Ohio Farmer, VIII, 1859, 290.

This species is so little known, probably because of its resemblance to the Bank Swallow, that reports are meager. Dr. Wheaton says, "Next to the Barn Swallow, this appears to be our most abundant species." Judging from my own

observations in several representative places in the state, such is not the case now. The term common better applies. These birds may be found about bridges, perpendicular rocky cliffs, and sometimes in company with the Bank Swallow, with which it nests to a limited degree. I have never seen it in such large companies as the Bank Swallow, but six to ten birds together is not uncommon. The nest is usually made in a crevice of the rocks, and is not made by the birds, although it may be cleared of loose earth or rubbish.

The food is not much unlike that of the other members of this group. It may be seen swinging back and forth over the fields or up and down a rock walled stream, usually feeding below the top of the cliffs.

The Rough-wing arrives a few days later than the Bank Swallow, and does not leave the streams before the middle of July. It has gone south by the first of September.

Family AMPELIDÆ. Waxwings.

Both waxwings have been found in Ohio, only the Cedar regularly. They are almost silent birds, having no true song and but a weak chatter. They are erratic in habits, usually occur in flocks, and frequently nest in our orchards. Their plumage is soft and delicate. The conspicuous crest is a good field mark.

226. (618.) AMPELIS GARRULUS Linn. 74.

Bohemian Waxwing.

Synonyms: *Bombycilla garrula*, *Lanius garrulus*.

Bohemian Chatterer, Northern Chatterer, European Chatterer, Waxed Chatterer, Northern Waxwing, European Waxwing.

Kirtland, *Am. Journal Sci. and Arts*, XL, 1841, 20.

There is nothing to add to what Dr. Wheaton has said about this winter bird. From that account it appears that the species was a somewhat regular winter visitor in the vicinity of Cleveland to about 1860. Since that time I have been unable to find records for Ohio. It is just possible that

the bird does reach our northern border sometimes still, but is not distinguished from the Cedar Waxwing. Observers should be on the watch during our cold weather, and especially be suspicious of any Waxwing which appears during such severe cold.

Dr. Kirtland states that these birds were "attracted by the berries of the mountain ash and hawthorn, and the fruit of the persimmon."

227. (619.) *AMPELIS CEDRORUM* (Vieill.). 75.
Cedar Waxwing.

Synonyms: *Bombycilla carolinensis*, *B. cedrorum*.

Cherry Bird, Cedar Bird, Carolina Waxwing, Southern Waxwing, Little Waxwing, Carolina Chatterer, Spider-bird.

Kirtland, Ohio Geol. Surv., 1838, 162.

This is a somewhat irregular species, but may be considered a common resident over the entire state. However, it is sometimes scarce or wholly wanting from some localities and abundant at others during the same time. It is generally seen in flocks even during the nesting season.

Its food consists of 13 per cent. animal and 87 vegetable matter. A few snails are eaten, but the bulk of the animal matter consists of beetles, with a few bark and plant lice. The vegetable matter is 87 per cent. wild fruit and seeds and only 13 per cent. cultivated fruits, with the probability that a large part of the raspberries and blackberries are also wild fruit. Early cherries are scarcely touched. At any time the Cherry-bird prefers mulberries to cherries. A single bearing mulberry-tree has saved a whole orchard of cherries. A Cherry-bird was brought to me which had killed itself by eating too many ripe mulberries. Taken the year through this bird is far more useful than harmful and should be protected.

Family LANIIDÆ. Shrikes.

The name "Butcher-bird" was applied to members of this family because of their habit of impaling their victims upon thorns. It was long supposed that they gloated over the

struggles and sufferings of their victims like veritable barbarians. That this is a libel on the character of the shrikes any one may prove by studying them at first hand. They are pretty fair singers, but the summer form is seldom heard singing unless one happens upon the performer unobserved. The Northern Shrike sings from his tree-top perch in the midst of a snowstorm in midwinter. All shrikes are solitary birds except while nesting and for some time after the young have left the nest.

228. (621.) *LANIUS BOREALIS* Vieill. 72.

Northern Shrike.

Synonyms: *Lanius septentrionalis*, *Collyrio borealis*, *Collurio borealis*.

Great Northern Shrike, Butcher-bird, Great American Shrike, Great Butcher Shrike.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

This solitary shrike is a winter resident over the entire state, but it is irregular south and rare everywhere, except occasionally along the lake front. It visits towns and villages during extreme weather for the sake of the hordes of English Sparrows. In the fields and woods it is always on the lookout for field mice or other rodents, and unwary sparrows.

The food of this bird consists of birds 35 per cent., insects 40 per cent., mice 25 per cent. Of the birds many are English Sparrows. While the other birds are useful species they constitute less than 25 per cent. of the whole food. It seems clear, therefore, that, contrary to his reputation, the Butcher-bird is one of our useful winter visitors and should be encouraged to visit the settlements where English Sparrows are to be so easily found. The habit of impaling its victims on thorns has grown out of the necessity of storing food against a time of scarcity, and is not an indication of the savage or barbarous instincts so often attributed to these birds.

The Northern Shrike reaches northern Ohio about the first of October and the southern counties a week later. It sometimes tarries until the first of April in Lorain county.

229. (622d.) *LANIUS LUDOVICIANUS MIGRANS* W. Palmer. 73 and 73a.

Migrant Shrike.

Synonyms: *Lanius ludovicianus*, L. l. *excubitorides*.
Loggerhead Shrike, White-rumped Shrike.

W. Palmer, Auk, XV, 1898, 257.

Awaiting the action of the A. O. U. committee on nomenclature upon the proposed subspecies *migrans*, there seems nothing left one but to accept this tentative name instead of reverting to the former now obsolete names, so far as the shrikes of Ohio are concerned. In the Oberlin College collection there are a few more specimens referable to *L. ludovicianus excubitorides* than to *L. ludovicianus*, with two or three specimens indeterminate. With such a condition illustrated by specimens taken within a few miles of Oberlin, this proposed creation of a new subspecies which shall eradicate the confusion hitherto so apparent, seems desirable. At any rate it is not wise to return to the old classification. The two names used by Dr. Wheaton will therefore refer to this new subspecies. It is clear from Dr. Wheaton's remarks that his mind was not at rest concerning the summer shrikes. The apparent shifting westward of the *excubitorides* form noted by him, and by Prof. Ridgway in Illinois, was not satisfactorily accounted for.

The food of this shrike differs from that of the Northern only in the larger percentage of insects eaten and the smaller percentage of birds. While feeding its young many snakes are killed, and many of the spiny caterpillars. Grasshoppers are eaten in quantities. It is clear, from the careful study of the food of this bird, and from the examination of stomachs, that it is far more beneficial than injurious, and should be protected at all times.

It appears certain that this form winters as far north as Columbus in small numbers. It is hardly common anywhere in the state, except locally. The southeastern counties are too deeply gashed and are so lacking in suitable nesting-places that it is practically absent from that region.

This shrike reaches northern Ohio about the middle of March and returns south about the first of October.

Family VIREONIDÆ. Vireos.

Of the six vireos found in Ohio four remain to breed, and one of the four is found only in the southern parts of the state. These birds closely resemble the warblers in habits and carriage, but are more deliberate in their movements, and glean from leaves rather than from the twigs and stems, but they must sometimes make sallies into the air for flying insects, and frequently act like warblers. They usually sing all the time between mouthfuls, and may be known by their songs even when other characteristics fail. For the most part they are sober-colored, one species having a yellow throat. Their colors are shades of gray with some green and yellow. In contrast to the warblers, they are not patchy in color.

The vireos are preëminently leaf gleaners, but they sometimes catch flying insects after the manner of the warblers. Their food is therefore more largely eggs and larvæ of insects than the winged forms. It is just possible that they may take a little ripe fruit in its season, but if so, in too small quantities to count.

230. (624.) VIREO OLIVACEUS (Linn.). 66.
Red-eyed Vireo.

Synonyms: *Vireosylvia olivacea*, *Muscicapa olivacea*.

Red-eyed Greenlet, Red-eyed Flycatcher, Red-eye, Preacher-bird.

Kirtland, Ohio Geol. Surv., 1838, 163.

This vireo is almost abundant in woods throughout the state. Its perpetual phrased song is likened to the admonitions of a preacher, and has given it the name of "Preacher Bird." Its woven pensile nest is an easy mark for the Cowbird, which is pretty sure to deposit one or more of its parasitic eggs in the nest. I have found three eggs of the Cowbird and but two of the rightful owner in one nest. The

duped vireo seems to offer no protest to this persistent imposition. The birds are not confined to the woods, but frequently nest in our city parks. The noise of traffic may almost completely drown the cheerful voice, but it cannot stop it.

This vireo reaches the lake shore about the 23d of April and departs about the 25th of October.

231. (626.) VIREO PHILADELPHICUS (Cass.). 67.
Philadelphia Vireo.

Synonyms: *Vireosylvia philadelphica*.

Brotherly Love Vireo, Brotherly Love Greenlet.

Baird, P. R. R. Report, IX, 1858, 335.

This vireo seems to be irregular as a migrant in Ohio. I have never found it in Lorain county, nor elsewhere in the state. If it were even fairly common it could hardly have escaped so many observers entirely.

Rev. Mr. Henninger found it late in April and again late in September, in southern Ohio.

232. (627.) VIREO GILVUS (Vieill.). 68.
Warbling Vireo.

Synonyms: *Vireosylvia gilva*, *Muscicapa gilva*.

Warbling Greenlet, Warbling Flycatcher.

Kirtland, Ohio Geol. Surv., 1838, 163, 180.

This is the vireo which lives in the shade trees and parks all summer. It is almost abundant over the entire state. The peculiar rolling song and rasping scolding notes must be familiar to all. They may be heard just outside your door at almost any time from May to August.

This vireo seems to travel with the Red-eyed Vireo, sometimes arriving a day or two earlier. Southern Ohio dates of arrival range from April 19 to May 9, while Lorain county arrivals range from April 28 to May 1. They have left the lake shore by September 15, but tarry a month longer in the southern counties.

233. (628.) VIREO FLAVIFRONS Vieill. 69.
Yellow-throated Vireo.

Synonyms: *Vireosylvia flavifrons*, *Lanivireo flavifrons*.
Yellow-throated Greenlet.

Kirtland, Ohio Geol. Surv., 1838, 163.

Most people are not acquainted with this vireo, probably because it prefers the taller timber and is seldom seen about human habitations. It is hardly common as a summer resident except in certain localities where tall oak timber is plentiful. Its song closely resembles the song of the Red-eyed, but may be readily distinguished after careful study of both.

This species arrives during late April, perhaps a little later than the two foregoing species, and remains until September.

234. (629.) VIREO SOLITARIUS. (Wils.). 70.
Blue-headed Vireo.

Synonyms: *Lanivireo solitarius*, *Muscicapa solitaria*.
Solitary Vireo, Solitary Greenlet, Blue-headed Greenlet.
Wheaton, Ohio Agri. Report, 1860, 365, 375.

Like the Yellow-throated Vireo, this is little known, partly because it seldom gets out of the woods, and partly because it is strictly a migrant across the state. Its song has a fairly close resemblance to the song of the Red-eyed Vireo, but it is not difficult to distinguish after a little study. I have found the Blue-headed on the College campus and in the shade trees lining our streets.

This vireo reaches Lorain county the first week in May, usually near the first; or even the last days of April, is fairly common for a week, and passes north about the 15th of May. It returns about the middle of September, remaining but a short time. It leaves southern Ohio shortly after the middle of October. A better acquaintance with this bird will undoubtedly prove it to be not uncommon during the migrations across the state.

235. (631.) VIREO NOVEBORACENSIS (Gmel.). 71.
White-eyed Vireo.

Synonyms: *Muscicapa noveboracensis*.

White-eyed Greenlet, Little Green Hangingbird, Chickity-beaver, Politician, Hanging Flycatcher, Green Flycatcher. Kirtland, Ohio Geol. Surv., 1838, 163.

The White-eyed Vireo is distinctly southern in its distribution, in Ohio. It is a fairly common summer resident in the southern half of the state, ranging at least to the southern border of Franklin county, but Dr. Wheaton did not find it at all at Columbus, nor have others found it there as more than a casual visitor. In the eastern half of the state it ranges north into Cuyahoga and Ashtabula counties, being fairly common at Jefferson all summer. There is no record for Lorain county. I did not find it in Medina county, where the conditions are unusually favorable, nor at either the Licking or Lewiston reservoirs. Dr. Wheaton regarded it as of local distribution over the state. If that be true at the present time evidence is lacking.

It reaches our southern border early in May and retires southward early in September.

Family MNIOTILTIDÆ. Wood Warblers.

The species of this family found in Ohio are both the most numerous and the most interesting of birds. Thirty-six species are regularly found, one has wandered from the east, and two belong to the Hypothetical List of the A. O. U. He who can resist the temptations to get into the woods which "Warbler Time" brings is hopeless from an ornithological standpoint! Most of them pass through the state twice each year, but fully fifteen species remain to breed while three others occasionally do. Some of the species which nest well north in the state in small numbers and are migrants elsewhere must be regarded as rare breeders, the most of the individuals passing well north to breed.

Most members of this group are insect eaters, but most of them also eat fruit and berries in their season, some of them to a considerable extent. Some are gleaners from leaf and

branch, some feed largely upon the ground, while some catch flying insects after the manner of the true Flycatchers. All are useful birds and none seem to be at all injurious.

236. (636.) *MNIOTILTA VARIA* (Linn.). 28.

Black and White Warbler.

Synonyms: *Mniotilta varia borealis*, *Sylvia varia*, *Motacilla varia*.

Black-and-white Creeper, Black and White Creeping Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

Dr. Wheaton gives this warbler as a "Common summer resident." It is so reported by a few observers well scattered about the state, but is regarded by most as common only during the migrations. My studies in different parts of the state have convinced me that it is to be found breeding in suitable places over the entire state, but is common only locally. It breeds sparingly about Oberlin. During the summer it must be sought in the deeper high woods. Its creeping habits and weak song make it an inconspicuous bird at best, and in the deep shadows of the woods it may be easily overlooked.

This warbler is among the first of the great host of warblers which pass across the state—a few of them remaining all summer—late in April and early in May. It appears on our southern border about April 25th, and our northern border about three days later. In Lorain county it is common up to the middle of May and then the few which remain to breed retire to the deeper woods. The last have left the county by the 25th of September.

237. (637.) *PROTONOTARIA CITREA* (Bodd.). 29.

Prothonotary Warbler.

Synonyms: *Motacilla citrea*.

Golden Swamp Warbler, Willow Warbler, Golden Warbler. Wheaton, Ohio Agri. Report, 1860, 363, 373.

The distribution of this handsome warbler is largely determined by the special conditions favorable to its breeding.

Dr. Wheaton says of it: "The Prothonotary Warbler is only known in this state as a summer resident in western Ohio, especially in the vicinity of St. Mary's reservoir." I have found it fairly common at Licking reservoir, in all three counties in which that reservoir lies; but it was not found at Lewiston reservoir in spite of the fact that breeding places seemed plentiful. In "Birds of Indiana," page 1022, Mr. Butler mentions a Cleveland record for this species. I have been unable to verify this record. Mr. Charles Dury reports its presence at Cincinnati and St. Mary's reservoir, as stated above. These are the only positive state records. It is likely that the bird occurs in other suitable localities in the state. Its local distribution is well illustrated by the finding of breeding birds in eastern Minnesota. There seems to be some indirect evidence that this species is extending its range northward where conditions are favorable.

I have no records of its migrations, but it must reach Licking reservoir early in May, for during the last week in May we found a nest which was the second for that pair of birds, the first having been robbed two weeks previously.

238. (639). *HELMITHEROS VERMIVORUS* (Gmel.). 30.
Worm-eating Warbler.

Synonyms: *Helminthoherus vermivorus*, *Sylvia vermivora*, *Helinaia vermivora*, *Motacilla vermivora*, *Vermivora pennsylvanica*.

Worm-eating Swamp Warbler, Worm-eater.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

Like the last species, this one is among those of more southern distribution. Dr. Wheaton regarded it as rare in summer. It now seems to be common in many places in the southern part of the state, and ranges well north in the eastern half, breeding in Cuyahoga and Ashtabula counties. There is a doubtful record for Lorain county. Without doubt this species is extending its range northward, and further study by trained men will no doubt greatly increase the Ohio records.

The Worm-eating Warbler reaches Ohio during the first

week in May and departs southward about the middle of September.

239. (641.) *HELMINTHOPHILA PINUS* (Linn.). 32.
Blue-winged Warbler.

Synonyms: *Helminthophaga pinus*, *Sylvia solitaria*, *Vermivora solitaria*, *Certhia pinus*.

Blue-winged Yellow Warbler, Blue-winged Swamp Warbler.
Kirtland, Ohio Geol. Surv., 1838, 163, 182.

This warbler is tolerably common during the migrations, but is less numerous as a breeding bird over the entire state. Given a wet woods with a fringe of brush and the Blue-wing is pretty certain to be present. One hearing of the curious song is enough to fix it in mind. While the nest is placed near the ground in the grass or rarely low bushes, the birds must usually be looked for in the tree-tops, or at least in the upper branches of the taller trees. If the bird be near the ground it is pretty certain proof of the presence of the nest.

This warbler reaches northern Ohio during the last week in April, and remains until the middle of September.

240. (642.) *HELMINTHOPHILA CHRYSOPTERA* (Linn.). 33.
Golden-winged Warbler.

Synonyms: *Helminthophaga chrysoptera*, *Sylvia chrysoptera*, *Vermivora chrysoptera*, *Motacilla chrysoptera*.

Blue Golden-winged Warbler, Golden-winged Swamp Warbler.
Kirtland, Ohio Geol. Surv., 1838, 163, 182.

The distribution of this warbler in Ohio seems to be almost identical with that of the Worm-eating Warbler, with the exception that it seems to be a little more northern. It has been found in Lorain county a half-dozen times, but is not known to have bred there. It is reported as breeding in Cuyahoga and Ashtabula counties, and is common locally in the southern half of the state. It also nests on the ground, but is not so fond of the tree-tops for a perch. It is unwary, permitting a near approach. Its lazily uttered *zee zee zee zee* is unlike the song of any other bird, but might be mistaken for an insect.

This Warbler reaches Lorain county during the first week in May. I have no autumn records of the return south. It probably tarries until the first of September at least.

241. (645.) *HELMINTHOPHILA RUBRICAPILLA* (Wils.). 34.
Nashville Warbler.

Synonyms: *Helminthophaga ruficapilla*, *Sylvia rubricapilla*,
Vermivora rubricapilla, *Sylvia ruficapilla*.

Nashville Swamp Warbler, Nashville Worm-eater.

Kirtland, Ohio Geol. Surv., 1838, 168, 182.

The Nashville Warbler is a common migrant, passing entirely across the state twice each year. It is not confined to the woods but is just as common in the parks and along the tree-lined streets, and in the door-yards among the fruit and ornamental trees, busily engaged in cleaning out the insect pests from bud and leaf.

This warbler reaches Lorain county about the first of May and is common for two and sometimes three weeks, often tarrying until the 23d of May. It returns in force early in September and remains about four weeks. There is little doubt that this is a late date for the return of this and many other warblers, but the records show no earlier dates.

242. (646.) *HELMINTHOPHILA CELATA* (Say). 35.
Orange-crowned Warbler.

Synonyms: *Helminthophaga celata*, *Sylvia celata*.

Wheaton, Ohio Agri. Report, 1860 363, 373.

Dr. Wheaton's statement that this is a "Rare spring and fall migrant" remains true to-day. The bird is little known. I have found it but a half-dozen times at Oberlin, and not more than one bird for each record. Once it was feeding in an orchard just out of the village, the other times in the woods low down in the brush.

My dates of spring migration fall within the first week of May. I have no autumn records.

- 243 (647.) *HELMINTHOPHILA PEREGRINA* (Wils.). 36.
Tennessee Warbler.

Synonyms: *Helminthophaga peregrina*, *Sylvia peregrina*, *Vermivora peregrina*.

Tennessee Swamp Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

This is probably the most numerous warbler of the shade trees and orchards during both spring and autumn migrations. It passes entirely across the state, none remaining to breed. In spring it literally swarms about our trees and lawns, but is unnoticed by the majority of people, because it is so small and because its song is so like that of the Chipping Sparrow, and some insects. In autumn it is more confined to the woods, but is not uncommon in orchards and shade trees. It is one of our best friends, gleaning everywhere for the eggs, larvæ or the perfect insects which do so great damage to fruit. Yet I have known of fruit growers who made war upon them for eating off the buds! They are after the bug that eats the bud or the fruit.

The Tennessee Warbler is among the later warblers to arrive, appearing about May 5, and remaining two weeks. It passes south again in September, leaving the state during the first week in October.

244. (648a.) *COMPSOTHYLPIIS AMERICANA USNEÆ* Brewst.
37 (part).

Northern Parula Warbler.

Synonyms: *Dendroeca tigrina*, *Perissoglossa tigrina*, *Sylvia americana*, *Parus americanus*, *Compsothlypis americana* (part).

Blue Yellow-backed Warbler, Parula Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

Judging only from the specimens in the Ohio State University and Oberlin College museums, six in all, this form is pretty clearly a regular migrant across the state in spring, during the first two weeks of May. There appear to be no breeding specimens in collections. It is not common anywhere, but is fairly numerous during favorable years for the spring migrations of the warblers.

245. (648b.) *COMPSOTHYLPIS AMERICANA* RAMALINÆ.
Ridgway. 37 (part).
Western Parula Warbler.

The synonyms and reference should stand as in the preceding form. In "Birds of North and Middle America," Vol. II, 486, Prof. Ridgway gives the following reference: Read, Proc. Ac. Nat. Sci. Phila., vi., 1853 (n. Ohio). Mr. H. C. Oberholser also informs me that this is likely the breeding form for Ohio. A specimen in the Ohio State University collection, and one in the Oberlin College collection, both taken rather late for the migratory movement, are decidedly small. In the absence of contradictory evidence it seems necessary to regard this form as the Ohio breeding Parula Warbler. It is little known in the breeding season, having been noted only by Dr. Langdon and Mr. Dury near Cincinnati. It would appear to be a little later than the preceding form in its migrations.

246. (650.) *DENDROICA TIGRINA* (Gmel.). 38.
Cape May Warbler.

Synonyms: *Dendroeca tigrina*, *Perissoglossa tigrina*, *Sylvia maritima*, *Sylvicola maritima*, *Motacilli tigrina*.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

The Lorain county records for this warbler number less than a dozen, all in the first week of May. There are no reports of any greater number anywhere in the state in the spring migrations, but Rev. Mr. Henninger notes it as common during the autumn migrations in Scioto county, "especially in upland beech woods." It is strictly a migrant in the state, stopping but a short time in spring, but passing south more leisurely.

It reaches southern Ohio late in April, and northern Ohio a week later; returning about the middle of September, and may be found in Scioto county as late as October 3.

247. (652.) *DENDROICA ÆSTIVA* (Gmel.). 39.
Yellow Warbler.

Synonyms: *Dendroica æstiva*, *Sylvicola æstiva*, *Sylvia æstiva*, *Motacilla æstiva*.

Summer Warbler, Summer Yellowbird, Blue-eyed Yellow Warbler, Golden Warbler, Yellow-bird, Yellow-poll Warbler, Wild Canary.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

This well-known warbler is our commonest summer warbler in all parts of the state. It has the capacity of accommodating itself to almost any conditions, seeming as much at home in the orchard or ornamental trees as in its primitive briar tangle in some drying swamp. Its nest may be within a few feet of the ground or in the tree-tops if necessary. As an inhabitant of the orchards it is kept busy with the insect pests which make the life of the fruit-grower miserable. Here it is a great aid in keeping in check fruit destroying insects.

The Yellow Warbler is among the earlier warblers to appear in spring, reaching our southern border before the 20th of April, or even during the first week of April, in favorable years. It is usually found at Oberlin about the 22d of April, often earlier. The departure in the autumn is not so easy to trace. I have found them in Oberlin as late as September 7. It is likely that individuals remain much later but the majority have gone before the first of September.

248. (654.) *DENDROICA CÆRULESCENS* (Gmel.). 40.
Black-throated Blue Warbler.

Synonyms: *Dendroica cærulescens*, *Sylvia canadensis*, *Sylvicola canadensis*, *Dendroica canadensis*, *Motacilla canadensis*, *M. cærulescens*.

Canadian Warbler, Pine Swamp Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

This is one of the fairly common migrants, passing entirely across the state twice each year. It is as often seen in parks and along shaded streets in spring as in the woods, but seems to avoid human habitations on its return journey. It is an inhabitant of the lower stories of the woods, even

feeding upon the ground, when the white wing-spot is conspicuous against the blue-black wing.

It reaches southern Ohio as early as the 15th of April in favorable years, but seldom appears at Oberlin before the first of May. It remains about two weeks, and returns again early in September or even late in August, to remain until about the first of October.

249. (655.) *DENDROICA CORONATA* (Linn.). 41.

Myrtle Warbler.

Synonyms: *Dendroica coronata*, *Sylvia coronata*, *Sylvicola coronata*, *Motacilla coronata*.

Yellow-rumped Warbler, Yellow-crowned Warbler, Yellow-rump, Myrtlebird, Yellow-rumped Wood Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

This is an irregular warbler, sometimes being abundant and again hardly even common. It is the earliest to appear in spring and the latest to depart southward in autumn. It does not breed in the state as far as known. In its northward movement it is well distributed in the woods and parks, but in its southward journey it prefers to travel in the more open country, often with the Chipping Sparrow. At such times it may be seen in the fields gleaning among the weeds like a sparrow, or searching for insects in weed stems. It derives its name from its fondness for the berries of the myrtle (*Myrica cerifera*).

During the spring passage of this species the insect food is greatly in the preponderance, although even then myrtle berries are eaten when they can be found, but during the autumn passage southward, when the fruit of the myrtle is abundant, it has been determined that fully 62 per cent. of the food is the myrtle berries. It seems remarkable that a bird supposed to be an insect eater should feed so largely upon this particular fruit. The myrtle berries are good for nothing, while the insects eaten are injurious. It is clear that this warbler deserves protection equally with the other warblers.

The Myrtle Warbler appears in Lorain county about the

middle of April, depending on the weather at that time, and tarries until the middle of May, or later sometimes. It returns late in September and is fairly common until the 20th of October, scattering individuals remaining into the first week of November.

250. (657.) *DENDROICA MACULOSA* (Gmel.). 42.
Magnolia Warbler.

Synonyms: *Dendroica maculosa*, *Sylvia magnolia*, *S. maculosa*,
Sylvicola maculosa, *Motacilla maculosa*.

Black and Yellow Warbler.

Wilson, *Am. Orn.*, III, 1811, 63.

Dr. Wheaton says of this species, "Abundant and regular spring and fall migrant in middle Ohio, summer resident in small numbers in north-eastern Ohio." At the present time it is generally regarded as not common as a migrant, except occasionally, when it becomes common. I find no evidence that this warbler now breeds within the state. While few of us find the first warblers on their return in late July or early August, it is well known that they migrate as early as that. Middle of the summer specimens do not, therefore, indicate that the birds have bred in the vicinity. Late June records would more likely indicate breeding birds.

The Magnolia Warbler reaches northern Ohio early in May, and the last has passed north about May 21. It returns late in July or early in August, judging from the records, and remains until about September 20.

251. (658.) *DENDROICA RARA* Wils. 43.
Cerulean Warbler.

Synonyms: *Dendroica cærulea*, *Sylvia azurea*, *S. rara*, *Dendroica cærulea*.

Azure Warbler, Blue Warbler.

Kirtland, *Ohio Geol. Surv.*, 1838, 163, 182.

Dr. Wheaton's statement, "Abundant summer resident," no longer applies to this woods-haunting warbler. It is universally reported as not common during the summer. It would be hard to assign a reason for this decrease in num-

bers, since the places where the bird now nests are numerous enough for its purposes. True, it does not go out of the taller woods to breed, but it seems to find woods enough suitable for breeding places. It may be, however, that during the earlier days it was confined to the deeper woods and the rapid disappearance of them has driven many to other regions. In Lorain county it is to be found in every considerable woods, but is only common here.

The Cerulean Warbler arrives with the warbler host, about the first of May in northern Ohio, and is fairly common for two weeks. The departure northward of a majority of the individuals leaves the state thinly settled with Ceruleans. It passes south during the last week of September.

252. (659.) *DENDROICA PENNSYLVANICA* (Linn.). 44.
Chestnut-sided Warbler.

Synonyms: *Dendroeca pennsylvanica*, *Sylvia icterocephala*, *Sylvicola icterocephala*, *Motacilla pennsylvanica*, *M. icterocephala*.

Quebec Warbler, Yellow-crowned Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

Of all the warbler host this is to me the most interesting, in its parti-colored dress and confiding ways. The day that brings them is the brightest day of the season. In their northward movement they are not particular about the places where they feed, provided the insects are numerous and the trees are not too far apart. Every year we see numbers of them on the College Campus. I have seen them in the doorway, in the apple-trees, and in the deep woods among the highest branches. It is common only locally, apparently. Dr. Wheaton gives it as a summer resident in the north-eastern parts of the state. It is not unlikely that it still breeds in the northern part of the state, but if so it has not been so reported to me. None have been found in summer in Lorain county.

This is one of the warbler host which reaches Oberlin about the first of May, remaining about two weeks and then

passing north. It returns early in September and remains until the last week of the month.

253. (660.) *DENDROICA CASTANEA* (Wils.). 45.
Bay-breasted Warbler.

Synonyms: *Dendroeca castanea*, *Sylvia castanea*, *Sylvicola castanea*.

Bay-breast.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

Apparently this warbler is not well enough known to make any statements of its spring migrations reliable. In Lorain county it is fairly common every spring, and usually more numerous in the autumn. That seems to be the general verdict, except that in many places the species is not at all common. The whole warbler group is perhaps less known by the average bird student than any other. The reason for this lack of acquaintance is not easy to explain, because the usually bright patchy coloring of these birds makes them somewhat conspicuous. Their small size and arboreal habits, and the difficulty of detecting them among the foliage, doubtless contribute largely to the difficulties.

This is among the later arrivals in spring, not appearing in Lorain county before May 5, generally, and has gone northward by the 23d. In its southward migrations it reaches Ohio about the middle of August, and tarries in the southern counties until the middle of October.

254. (661.) *DENDROICA STRIATA* (Forst.). 46.
Black-poll Warbler.

Synonyms: *Dendroeca striata*, *Sylvia striata*, *Sylvicola striata*, *Muscicapa striata*.

Black-poll.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

This warbler arrives even a little later in spring than the Bay-breast, and is frequently associated with it. Judging from the reports it is a little more numerous in spring and fully so in the autumn. Fall specimens of these two warblers are so nearly alike that one not well acquainted with

them will probably not be able to distinguish between them in life. A good pair of field glasses, such as the 8-power prism glasses, usually makes their identification possible at a range of twenty-five yards. But under any circumstances close scrutiny is necessary to detect the tint of cream-buff on the underparts of the Bay-breast and the distinctly yellow tint of the same parts of Black-poll. Both species are wood birds, but they also feed in wooded parks within the city limits, at times. In their southward migrations they are partial to the hillsides bordering streams where the trees are not so tall.

The Black-poll does not reach Oberlin until after May 10, and remains but a week or ten days. It returns during the last half of August and does not leave our southern border before the 10th of October.

255. (662.) *DENDROICA BLACKBURNIÆ* (Gmel.). 47.
Blackburnian Warbler.

Synonyms: *Dendroica blackburniæ*, *Sylvia blackburniæ*, *Sylvicola blackburniæ*, *Motacilla blackburniæ*.

Hemlock Warbler, Orange-throated Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

Dr. Wheaton regarded this beautiful warbler as an abundant migrant. It appears to have decreased in numbers until it is only common in most parts of the state, and uncommon in others. At Oberlin it is usually common during both migration periods. It is a bird of the tree-tops, seldom descending below the middle story of the woods, unless the weather be inclement. It is one of the few birds which attract the attention of the casual passer whose eyes are ever raised above the ground. Its brilliant orange throat gleams like a sunbeam amid the foliage.

This winged Prometheus comes with the opening buds near May-day, usually after rather than before, and remains until the foliage hides him. During the first two weeks only males in brilliant dress may be found, but during the last week these have made way for the host of plainer colored females. The last are seen about May 22. The return

may be as early as the middle of August, the last passing south about September 25.

256. (663a.) *DENDROICA DOMINICA ALBILORA* Ridgw. 48.
Sycamore Warbler.

Synonyms: *Dendroica dominica* var. *albilora*, *Sylvia pensilis*,
Sylvicola pensilis, *Dendroica superciliosa*, *D. dominica*.
White-browed Yellow-throated Warbler, White-cheeked
Warbler.

Kirtland, Am. Journal Sci. & Arts, XL, 1841, 21. The first reference for the subspecific name as it now stands should be Ridgway, Am. Nat., VII, 1873, 606.

This species appears to breed sparingly across the state, but is known by few observers. I have never seen it. Dr. Wheaton states that it is the earliest of all the warblers in spring, even preceding the Myrtle. If it has passed through Lorain county it has entirely eluded careful search for a half-dozen years. It certainly does not breed in the western half of the county or it would have been found at some time. It has actually been found breeding at Cleveland, Mt. Vernon, Wauseon, and Cincinnati. More careful search for this early warbler should reveal its presence in many parts of the state where it is not now known even as a migrant.

Reliable migration dates are wanting, but it appears that the birds should be looked for early in April, and that some remain in the southern counties well into October. Sycamore groves appear to be the favorite places for these birds.

257. (667.) *DENDROICA VIRENS* (Gmel.). 49.
Black-throated Green Warbler.

Synonyms: *Dendroica virens*, *Sylvia virens*, *Sylvicola virens*,
Motacilla virens.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

Unlike the two following species, this one is among our commonest migrant warblers. Dr. Wheaton's designation of "Abundant spring and fall migrant," still applies. It is common in the woods, but seems to prefer the lawns, parks,

and shaded streets. At almost any hour of the day, during the first two weeks of May, several may be heard singing about the library building on the Oberlin College campus. It is no less numerous anywhere else in the state, judging from the reports.

In the spring migrations it reaches southern Ohio about April 25 and the lake shore about two days later; passing north about May 20, but often remaining several days longer, singing all the time. The first return during the latter part of August and tarry into the first week of October. It is just possible that a few pairs remain to breed in the northern counties.

258. (670.) *DENDROICA KIRTLANDI* Baird. 50.
Kirtland Warbler.

Synonyms: *Dendroica kirtlandi*, *Sylvicola kirtlandi*.

Baird, Ann. Lye. N. Y., V. 1852, 217.

Our state enjoys the honor of furnishing the type specimen of this rare and little known species, and to Charles Pease belongs the coveted honor of securing that specimen. The state records should be brought down to date. The name of the collector, place and date are given.

Charles Pease, near Cleveland, May 13, 1851 (type).

R. K. Winslow, near Cleveland, June (May?), 1860.

Charles Dury, Cincinnati, first week in May, 1872.

W. and J. Hall, Rockport (Cuyahoga county), May, 1878.

H. E. Chubb, Cleveland, May 4, 1880.

H. E. Chubb, Cleveland, May 12, 1880.

L. S. Keyser, Springfield (?), 1891.

Lynds Jones, Oberlin, May 11, 1900.

Lynds Jones and W. L. Dawson, near Ironton, August 28, 1902 (two).

No other state can boast so many specimens, but Michigan is fast approaching us in numbers. Better acquaintance with the species and greater activity in field work will probably prove this supposedly rare warbler not "The rarest of all the warblers."

259. (671.) *DENDROICA VIGORSII* (Aud.). 51.
Pine Warbler.

Synonyms: *Dendroeca pinus*, *Sylvia pinus*.
Pine-creeping Warbler, "Vigor's Vireo."

Wheaton, Ohio Agri. Report, 1860, 364.

This is another of the almost ornithological mysteries to the writer. I have found just one specimen in Lorain county, and that one an early migrant. It is reported as a rare migrant by most persons, but is reported on good authority as breeding in the southern part of the state. Dr. Wheaton did not know of any record of its breeding. Beyond doubt it should be one of the breeding warblers of the state. It needs careful looking after by competent field observers everywhere.

Migration dates are meager, but they indicate that this warbler makes its appearance late in April, and departs about October 10 from the southern counties.

260. (672.) *DENDROICA PALMARUM* (Gmel.). 52.
Palm Warbler.

Synonyms: *Dendroeca palmarum* var. *palmarum*, *Sylvia petechia*, *Sylvicola ruficapilla*, *Motacilla palmarum*.
Red-poll Warbler, Red-poll.

Kirtland, Ohio Geol. Surv., 1838, 163.

The general verdict is that this warbler is not common as a migrant. In some regions it seems to be fairly common, and probably is sometimes so in most localities. It is a bird of the underbrush, mostly, and will not often be seen with the other warblers. It seems to be fond of feeding about and in old brush-piles in spring, and wanders along railroad tracks and fence rows during its southward migration.

The Palm Warbler reaches the state about May 22 and remains two weeks or more if conditions are favorable. It returns during the first week of September and remains about a month.

261. (673.) *DENDROICA DISCOLOR* (Vieill.). 53.
Prairie Warbler.

Synonyms: *Dendroica discolor*, *Sylvicola discolor*, *Sylvia discolor*.

Red-backed Warbler, Parti-colored Warbler, Pasture Warbler, Wildwood Warbler.

Audubon, B. Am., II, 1841, 68.

This interesting little warbler is little known by Ohio ornithologists, who regard it as a rare migrant. There are two Lorain county records of single specimens which did not remain to breed. Dr. Wheaton states that it breeds in northern Ohio but is migratory in the southern half. It should be found breeding wherever it is found in the state, but its rarity makes any records notable. Rev. Mr. Henninger regarded the specimen taken in Scioto county on October 8, 1894, as accidental. It will be found in brushy pastures and shrubby clearings, not in the woods. It is usually so confiding that a near approach is easy. Its song will not fail to arrest the attention of any one who has an ear for strange sounds. This is a warbler which all should be watchful for during the early days of May.

Migration dates are almost entirely lacking, but it is likely that records will fall within the first five days of May, for the first appearance in spring, and somewhere near the first of October for the departure in autumn from the southern counties.

262. (674.) *SEIURUS AUROCAPILLUS* (Linn.). 54.
Oven-bird.

Synonyms: *Siurus auricapillus*, *Sylvia aurocapillus*, *Motacilla aurocapillus*, *Turdus aurocapillus*.

Golden-crowned Thrush, Accentor, Golden-crowned Accentor, Golden-crowned Wag-tail Warbler, Wagtail, Land Kickup.

Kirtland, Ohio Geol. Surv., 1838, 163.

The Oven-bird is a common summer resident over the entire state, and may be abundant in suitable localities. It must have dark woods, preferably damp, but not swampy. In hilly regions it frequently nests well up on the hillside.

Its oven-shaped nest is not readily seen among the dead leaves, of which the exterior is made. The crescendo chant is one of the characteristics of some woods. The bird's dress so harmonizes with the environment that the chant may well be considered a spirit chant coming from everywhere and nowhere. The birds seldom mount high in the trees, but remain near the ground, *walking* about as any civilized bird should.

The Oven-bird reaches Oberlin near the 24th of April, sings until July 10, rarely later, and leaves us for the south during the last week of September, sometimes later.

263. (675.) *SEIURUS NOVEBORACENSIS* (Gmel.). 55.
Water-Thrush.

Synonyms: *Siurus nævius*, *Sylvia noveboracensis*, *Turdus noveboracensis*, *Motacilla nævia*, *M. noveboracensis*.

Water Wagtail, Water Thrush, Small-billed Water-Thrush, Bessy Kickup, River Pink, Aquatic Accentor, New York Aquatic Thrush.

Kirtland, Ohio, Geol. Surv., 1838, 163, 181 (part).

This warbler is hardly common in most sections of the state. It is sometimes almost so at Oberlin, for a few days in spring. Like the other members of this genus it is a lover of damp places, preferring those that are somewhat swampy, while with us. I have never seen it higher up in the trees than ten feet, and then only when it was greatly disturbed. Its wild ringing song is given from a low perch or from the ground. When being pursued the bird has a habit of darting off and returning behind the pursuer or silently running ahead several rods and flitting close to the ground to appear far at one side. The quest is a nerve-wearing one, but if once in a dozen times you see the bird a moment before he glides away that is reward enough. You don't wish to have all birds perch on your nose!

The Water-Thrush reaches Oberlin about the 3d of May and passes north with the warbler host about May 22. It returns during the early days of September and remains until the 1st of October.

264. (676.) SEIURUS MOTACILLA (Vieill.). 56.

Louisiana Water-Thrush.

Synonyms: *Siurus motacilla*, *Sylvia noveboracensis*, *Turdus noveboracensis*, *Seirus ludovicianus*, *Turdus motacilla*.

Large-billed Water-Thrush, Large-billed Accentor, Water Wagtail, Large-billed Wagtail Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 181 (part).

This is really the earliest of all the warbler group, but does not get the credit it deserves because its name is not warbler. I have found it at Oberlin the last of March. It is only locally common as a summer resident in the state; in most places it is not common, but can hardly be considered rare. In Lorain county it is pretty strictly confined to the deep stream gorges or to the hills and banks at the lake shore. Somewhere in every stream gorge a pair or more may be found during the summer. Of course the gorges must be wooded, and with a stream flowing at the bottom. This species prefers to remain on the ground, seldom perching in a tree unless disturbed about its nest or young. Its wild song echoes and reëchoes in the steep walled gorge, recalling the untamed spirit of the Red man whose hunting ground this once was.

The average dates of arrival for this species fall within the first week of April, for southern Ohio, and a week later for Lorain county. The last ones leave the state during the middle of October.

265. (677.) GEOTHLYPIS FORMOSA (Wils.). 58.

Kentucky Warbler.

Synonyms: *Oporornis formosa*, *Sylvia formosa*, *Myiodiactes formosa*, *Sylvicola formosa*.

Kentucky Yellow-throat.

Audubon, Orn. Biog., 1, 1831, 196.

Dr. Wheaton says of this warbler, "Rare summer resident; in particular localities only." It is now fairly common over most of the southern third of the state, and ranges nearly to the lake in the western half, and rarely to the lake in the

eastern half of the state. There are three probable records of its occurrence in Lorain county.* In the rougher parts of the state this warbler is to be found in the gorges well grown with brush and trees. It seems partial to the steep hillsides in such localities.

The first appear in southern Ohio during late April or early May, and return south late in September.

266. (678.) *GEOTHLYPIS AGILIS* (Wils.). 57.
Connecticut Warbler.

Synonyms: *Oporornis agilis*, *Sylvia agilis*, *Trichas agilis*.
Kirtland, Ohio Geol. Surv., 1838, 162, 182.

This is one of the rare warblers which pass entirely across the state. Dr. Wheaton recorded five specimens taken in the state. The unquestionable records since 1882 are hardly more. But three have been recorded for Lorain county, one of them May 24, 1902. It must be looked for on or near the ground in brushy places, but not necessarily where it is wet. The birds are timid and retiring, but may be closely approached with care. I have never heard the song to know it.

The migrations appear to occur rather late in spring, and the return in fall is during the early part of August.

267. (679.) *GEOTHLYPIS PHILADELPHIA* (Wils.). 59.
Mourning Warbler.

Synonyms: *Sylvia philadelphia*.
Philadelphia Warbler, Black-throated Ground Warbler.
Wheaton, Ohio Agri. Report, 1860, 363, 373.

While this species seems to be more numerous than the last, it is by no means common anywhere in the state. It does not remain to breed, but passes north of our border. During their migrations these birds are to be found on or near the ground, rarely mounting into the lower branches of the trees. They seem to prefer brushy tangles within

*Since the above was written a specimen has been secured at Oberlin by the writer.

the woods, and have been found only in rather damp places in Lorain county. They are usually silent while here.

The individuals recorded at Oberlin have been among the latest arrivals—between the 10th and 15th of May. They remain but a week or ten days and then pass northward, returning early in August.

268. (681d.) GEOTHLYPIS TRICHAS BRACHIDACTYLA
(Swain). 60.
Northern Yellow-throat.

Synonyms: *Geothlypis trichas*, *Sylvia trichas*, *Trichas marylandica*, *Turdus trichas*.

Yellow-throated Ground Warbler, Ground Warbler, Black-masked Ground Warbler, Black-cheeked Ground Warbler, Black-necked Yellow-throat, Briar Wren, Yellow Briar Wren, Maryland Yellow-throat.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

This little brush warbler is everywhere common, and locally abundant in Ohio. It will be found in the brushy woods, weed-grown swales, or sloughs, in second-growth slashings, or in the fringe of brush surrounding high woods. In general it prefers damp situations, but may nest almost anywhere if the conditions are suitable for a nest. No doubt there are places in the hilly south-eastern parts of the state where this bird is rare if present, because the conditions which entice him are wanting.

The Northern Yellow-throat reaches Ohio during the last week in April and is soon common even to the northern counties. It sings during its entire stay, leaving the state early in October.

269. (683.) ICTERIA VIRENS (Linn.). 61.
Yellow-breasted Chat.

Synonyms: *Icteria viridis*, *Turdus virens*, *Muscicapa viridis*.
Yellow Mockingbird.

Audubon, Orn. Biog., II, 1834, 223.

This large unwarbler-like warbler is far more common in the southern counties than at the lake shore. Apparently the gradation is a nearly uniform one from the Ohio

river to Lake Erie. It is locally abundant in the southern counties and is almost rare in the northern, except locally, where it may become fairly common. This is another thick-et loving bird, and is found in nearly the same situations as the Maryland Yellow-throat, but in the smaller growth of trees. The birds live higher up, and usually nest higher; but, like the Yellow-throats, they must have brushy conditions, at least.

The Chat reaches Oberlin about the first of May and tarries until the first week of September.

270. (684.) *WILSONIA MITRATA* (Gmel.). 62.
Hooded Warbler.

Synonyms: *Myiodioides mitratus*, *Sylvania mitrata*, *Motacilla mitrata*.

Hooded Fly-catching Warbler, Mitred Warbler, Black-headed Warbler, Selby's Warbler.

Read, Fam. Visitor, III, 1853, 367.

The summer distribution of this warbler is somewhat peculiar. In general it is more common southerly than northerly, but about Jefferson it is almost common. It is reported as rare during the summer near Cleveland. There is but a single record for Lorain county, and that was not a breeding bird.* It is certain that the species would have been found if it breeds in the vicinity of Oberlin. Even in the southern counties it is only locally common.

The Hooded Warbler frequents the undergrowth of the woods, but often mounts high up among the branches to sing. Its nest is in the undergrowth. In my experience the preferred nesting-place is in some rather flat woods among the spice bushes or other shrubbery which grows well under tall trees.

The migration records are somewhat uncertain, but seem to be during the first week of May and the last week of September.

*Since the above was written another specimen has been found at Oberlin.

271. (685.) *WILSONIA PUSILLA* (Wils.). 63.
Wilson Warbler.

Synonyms: *Myiodioctes pusillus*, *Sylvia wilsonii*, *Muscicapa pusilla*.

Green Black-capped Fly-catching Warbler, Green Black-capped Yellow Warbler, Wilson's Black-cap, Black-capped Yellow Warbler.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

Wilson Warbler is strictly migratory, passing completely across the state both spring and autumn. Dr. Wheaton said of it, "Not common migrant in spring; abundant in fall." I have never found it common at Oberlin in spring, and even less numerous in fall. Its numbers appear to have decreased since Dr. Wheaton's time. It may be found in the shrubbery of woods, or even well up in the trees, when migrating. I have found it in orchards not infrequently, in company with the other migrating host of warblers.

This warbler is usually rather late in putting in an appearance, but the fact that it is sometimes recorded late in April argues that it may well be placed with the group of warblers which arrive about May 1. It passes north about May 20, and returns early in August, to remain three weeks or more.

272. (686.) *WILSONIA CANADENSIS* (Linn.). 64.
Canadian Warbler.

Synonyms: *Myiodioctes canadensis*, *Sylvia pardalina*, *Sylvicola pardalina*, *Muscicapa canadensis*.

Canada Fly-catching Warbler, Canadian Fly-catching Warbler, Speckled Canada Warbler, Necklaced Warbler, Canada Flycatcher.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

The Canadian Warbler should be found as a migrant anywhere in the state, both spring and autumn. It is not as numerous as many species, but is certain to be seen during each migration if one be on the lookout for it. I have found it more frequently in the higher woods than elsewhere, but it also feeds in the shade trees and orchards. In the woods it prefers the middle stories of the trees.

At Oberlin this warbler makes its appearance about May 7, remaining until about the 20th. It returns early in August and individuals may be found as late as September 25.

273. (687.) *SETOPHAGA RUTICILLA* (Linn.). 65.
American Redstart.

Synonyms: *Muscicapa ruticilla*.

Redstart, Redstart Warbler, Redstart Flycatcher.

Kirtland, Ohio Geol. Surv., 1838, 163.

Redstart is a common summer resident everywhere in the state, and in many localities is really abundant. It is partial to woods which contain many small trees among the larger timber. I have never found it nesting in deep woods devoid of underbrush or some small growth, but it is usually numerous in small second-growth timber.

It reaches the state during the last week in April, and has passed to the lake shore by the 1st of May. None are seen in Lorain county after September 25, but a few individuals may tarry in southern Ohio until the middle of October.

Family MOTACILLIDÆ. Wagtails.

The single species which inhabits Ohio is generally found in flocks in the spring and fall months, and may linger into the winter in the middle and southern parts of the state. Its usually small numbers make it unimportant economically.

274. (697.) *ANTHUS PENSILVANICUS* (Lath.). 27.
American Pipit.

Synonyms: *Anthus ludovicianus*, *A. spinoletta*, *Alauda pensilvanica*.

Brown Lark, Titlark, Pipit, Louisiana Pipit, American Titlark, Wagtail, Prairie Titlark, Reddish-brown Titlark, Louisiana Lark, Hudsonian Wagtail.

Kirtland, Ohio Geol. Surv., 1838, 163, 182.

The Pipit is so erratic in its movements that one is at a loss what to say about it. It is hardly common for more than a few days at a time, if a flock be regarded as an indi-

vidual. The most of my dates of first appearance fall within the first week of May, but there is one record for March 15, 1901. The last have gone north by May 20. I have but one autumn record, which is October 19, 1896.

While the Pipit is a bird of the fields it may also perch in trees, and in that particular differs from the Horned Larks, which it somewhat closely resembles in general habits and appearance. The slight wag to the tail is always a good field mark.

From the habits and haunts of these birds one would conclude that their chief food must be the larvæ of insects, with perhaps a good deal of weed seed or grain of one sort or another. They are fond of searching over newly plowed fields, where they may be seen feeding.

Family TROGLODYTIDÆ. Mockers, Thrashers, Wrens.

This family is so varied that it seems best to subdivide it into the two subfamilies.

Subfamily MIMINÆ. Mockers, Catbirds, Thrashers.

To this subfamily belong the larger birds which are nearly the size of the Robin. Three species occur in Ohio, one of them rarely, while the other two are common enough to be well known. The Catbird is the familiar slate-colored bird of the brushy tangles of the woods or garden, while the Brown Thrasher is more often seen along hedgerows where it nests. All members of this subfamily are famous singers and mockers.

275. (703.) MIMUS POLYGLOTTOS (Linn.). 7.

Mockingbird.

Synonyms: *Turdus polyglottus*.

Mocking Thrush, Mimic Thrush.

Kirtland, Ohio Geol. Surv., 1838, 163, 181.

As an Ohio bird the Mockingbird is certainly rare. The unquestioned records seem to be as follows: Cincinnati, Langdon, Dury; Waverly, Henninger; Perry, Beeman;

Morgan, Morris, Arrick, Davie; Oberlin, Jump (specimen); Columbus, Wheaton, Davie. The Cleveland records need confirmation. In Morgan county they were present all summer in 1896, and in the autumn of that year twenty birds were to be found. The same colony returned in 1897 but left during the cold May and June of that year, and have not been found since. There are a number of unconfirmed records of the Mockingbird from northern Ohio which may prove to be good records. But the likelihood of the presence of escaped cage-birds in the vicinity of cities, from which these reports come, throws some doubt upon the records.

Since the above was written Mr. C. H. Morris writes me that on January 25, 1903, in company with Mr. E. J. Arrick, he found and captured a Mockingbird near McConnellsville. Let us hope that this is an indication of an invasion of this beautiful singer and mimic.

276. (704.) *GALEOSOPTES CAROLINENSIS* (Linn.). 8.
Catbird.

Synonyms: *Mimus carolinensis*, *Turdus felivox*, *Mimus felivox*,
Muscicapa carolinensis.

Cat Flycatcher, Merle Catbird, Chat.

Kirtland, Ohio, Geol. Surv., 1838, 163.

Catbird is everywhere common during the summer, and abundant in many localities. It is probably too well known to make necessary the mention of its brush-loving proclivities. It is bold enough to make its summer home in the door-yard if a suitable nesting-place be furnished.

Forty-four per cent. of the Catbird's food consists of insects, and 56 per cent. vegetable matter. Of this 56 per cent. only one-third consists of fruit which might be cultivated. In most parts of Ohio it is certain that a large part of the fruit eaten is wild fruit. Hence the Catbird is really a decidedly beneficial bird. It cannot be denied that he eats some fruit on occasion, and may be punished for it. He is neither a witch nor a wizard, as many persons seem to think, but a plain everyday sort of bird, mostly concerned with his own business, wanting nothing only to be let alone.

The Catbird reaches the state shortly after April 20, rarely earlier, and soon becomes common. The bulk of the species has gone south by the 10th of September, but individuals may remain well into October.

277. (705.) *TOXOSTOMA RUFUM* (Linn.). 9.
Brown Thrasher.

Synonyms: *Harporhynchus rufus*, *Turdus rufus*, *Mimus rufus*.
Brown Thrush, Thrasher, Sand Mockingbird, French Mockingbird, Ferruginous Thrush, Fox-colored Mockbird.

Kirtland, Ohio, Geol. Surv., 1838 163.

Although fairly common, the Brown Thrasher is far less numerous than its cousin, the Catbird. It is a great lover of hedgerows and overgrown line fences where narrow thickets have formed. It may also be found in brushy tangles, but not in woods proper.

Sixty-four per cent. of what the Brown Thrasher eats is animal matter, mostly injurious insects, while only 36 per cent. is vegetable. This bird also eats fruit in its season, but the bulk of its vegetable food is of no use to man. It is one of the distinctly beneficial species which sometimes does some damage.

Contrary to what we might expect, this bird is an early April arrival from the south, rarely appearing late in March. The late snow-storms do not seem to inconvenience it. Individuals may be found during the first week in October.

Subfamily TROGLODYTINÆ. Wrens.

Six species of wrens are found in Ohio. In the north the House, and in the south Carolina and Bewick are familiar about dwellings. The two Marsh Wrens have spoiled their voices by living so much in the damp of the marshes, but the other members of the group are good singers. The tireless energy of these birds makes the classical ant look to his laurels. We have nothing but commendation for the services rendered by these birds, even if they do occasionally usurp the dwellings of other birds.

278. (718.) *THRYOTHORUS LUDOVICIANUS* (Lath.). 21.
Carolina Wren.

Synonyms: *Troglodytes ludovicianus*, *Sylvia ludoviciana*.

Great Carolina Wren; Mocking Wren, Louisiana Wren, Hammock or Hummock Wren, Palmetto Wren, Large Wood Wren.

Kirtland, Ohio Geol. Surv., 1838, 168, 183.

Dr. Wheaton's statement, "Abundant in Southern, common and resident in Middle, rare in Northern Ohio," still holds good in the main. There is good evidence that its northern range is extending, and that the birds are becoming more common north than he knew them. They seem to be resident wherever they occur. We found them on East Sister Island, Lake Erie, and there are records even into Ontario.

In many places this wren is as familiar as the House Wren, building under the porch roof. It is fond of brushy tangles and bushy ravines or gorges. The borders of streams afford good cover.

The food of this wren is almost entirely animal, and the most of that insects. It is likely that in winter more vegetable waste may be eaten if other food is hard to secure, but at any time this large wren is one of the most beneficial of our birds.

279. (719.) *THRYOMANES BEWICKII* (Aud.). 22.
Bewick Wren.

Synonyms: *Thryothorus bewickii*, *T. b. var. bewickii*, *Troglodytes bewickii*.

Southern House Wren, Long-tailed House Wren, Song Wren, Long-tailed Wren.

Dury and Freeman, Journal Cin. Soc. Nat. Hist., II, 1879, 101.

While Dr. Wheaton and Dr. Langdon admitted this wren to their earlier lists they removed it from their later ones because the records upon which statements were made proved unfounded. The above reference is the first authentic record.

It appears that this wren, which was unknown as an Ohio bird in 1882, has extended its range northeastward almost

if not quite to our northern border as far east as Oberlin, where it has twice been recorded within the last five years. It is gradually but surely replacing the House Wren in the southern counties, possibly because it is the resident form while the House Wren migrates. It is common now as far east as Scioto county, and nearly as far north as Columbus.

The food of this wren does not differ materially from that of the Carolina Wren. It is distinctly beneficial in its food habits.

280. (721.) TROGLODYTES AEDON Vieill. 23.

House Wren.

Synonyms: *Troglodytes domesticus*, *Motacilla domestica*.

Eastern House Wren, Short-tailed House Wren, Wood Wren.

Read, Proc. Phil. Acad. Nat. Sci., VI, 1853, 396.

The House Wren, once a common summer resident in all parts of the state, is now being forced out by the invasion of Bewick Wren. It does not appear to be increasing in those parts of the state not yet covered by the last species, but is holding its own there. I have been disappointed in not finding more House Wrens about the houses. The woods are much more preferred in Ohio than in the central parts of Iowa. In certain parts of every town this wren may be found, but it is not present everywhere that a place offers.

The food consists almost wholly of insects that harm fruit-trees. It has lately been discovered that if a pair of House Wrens are driven from a box or other nesting-place which they have selected, and are permitted to nest in the vicinity, they will destroy the eggs of any birds which may nest in that place desired by them but denied them. One would not suppose vindictiveness to be a vice of Jenny Wren.

The House Wrens appear in southern Ohio about the middle of April, and a week later at Oberlin. They return south about October 1.

281. (722.) *OLBIORCHILUS HIEMALIS* (Vieill.). 24.
Winter Wren.

Synonyms: *Anorthura troglodytes* var. *hyemalis*, *Troglodytes europæus*, *T. hyemalis*, *T. parvulus* var. *hyemalis*, *Sylvia troglodytes*.

Bunty Wren.

Kirtland, Ohio Geol. Surv., 1838, 163.

Dr. Wheaton stated that this little wren is a common winter resident. It is now not at all common in most localities. Possibly its small size and lowly habits cause it to be overlooked. It is more numerous during the migrations, in Lorain county, than during the winter, arguing that the majority of individuals pass farther south to winter.

During the winter it haunts brush-piles, where it is able to pick up a respectable living of animal matter, and the stream gorges, probably passing the nights in the little caves in the rocks.

Individuals may be found as late as May 10, in spring. I have never found one before the 10th of October in autumn.

282. (724.) *CISTOTHORUS STELLARIS* (Licht.). 26.
Short-billed Marsh Wren.

Synonyms: *Troglodytes brevirostris*, *Troglodytes stellaris*.
Fresh Water Marsh Wren, Meadow Wren.

Read, Proc. Phil. Acad. Nat. Sci., VI, 1853, 395.

This is a rare bird in Ohio. It appears to breed in suitable localities anywhere in the state, but is too rare to be noticed by any but the ornithologist who is on the lookout for it. There are two Lorain county records, but neither of them of breeding birds.

Unlike the next species, this wren does not prefer the large marshes, but rather wet lands which have a rank growth of coarse grass. Here the birds build their mouse-like nest, lashing it to the grass stems. I have never seen the birds in brushy places, nor in the immediate vicinity of true marshes.

The food differs from that of the more arboreal wrens only in the kinds of insects eaten.

Its Ohio migrations cannot be accurately given because we have no data. It is likely that the birds reach Ohio during the first ten days of May, and depart southward again during the middle of September.

283. (725.) TELMATODYTES PALUSTRIS (Wils.). 25.
Long-billed Marsh Wren.

Synonyms: *Cistothorus palustris*, *Troglodytes palustris*, *Motacilla palustris*, *Certhia palustris*.

Salt-water Marsh Wren, Marsh Wren.

Kirtland, Ohio Geol. Surv., 1838, 163.

This Marsh Wren is abundant about most of our large marshes. Regions without marshes or marshy conditions will not be visited by this species. I found them literally swarming at Licking and Lewiston reservoirs, Sandusky Bay marshes and Chippewa Lake. A few pairs remain in the rapidly narrowing marshes at Lorain and Oak Point.

These birds are true swamp birds, lashing their nests to reeds and cat-tails which stand in the water. In my mind they are associated with Coot, Florida Gallinule, and Black Tern.

The food is largely insects, and probably also some other small animals inhabiting such regions.

This wren reaches Lorain county during the first five days of May, and is gone by the middle of September.

Family CERTHIIDÆ. Creepers.

284. (726.) CERTHIA FAMILIARIS AMERICANA (Bonap.).
20.
Brown Creeper.

Synonyms: *Certhia familiaris*, *C. f. rufa*, *C. americana*.

American Creeper, Little Brown Creeper.

Kirtland, Ohio Geol. Surv., 1838, 164.

The Brown Creeper is sometimes common during the migrations, but is less common as a winter resident over the entire state. His small size and weak voice and resemblance to the bark of trees serve to hide him from all but

the inquiring eye. In winter he prefers the deep woods, though often found in towns; but during the migrations he frequently pursues his search for insects and larvæ in the bark of our shade trees. In winter I have usually found him among the company of nuthatches, woodpeckers, and titmice.

In spring he tarries well into May, returning late in September.

Family PARIDÆ. Nuthatches and Titmice.

Subfamily SITTINÆ. Nuthatches.

The nuthatches are so different from all other birds in their manner of feeding that they attract attention at once. They much prefer to cling head downward on a perpendicular tree trunk, prying into the crevices of the bark, or "hatching" the kernel from some nut or seed. They always want to know what you are and what you propose to do about it. They are poor singers, but the voice is strong and carries far. The term "sapsucker" is wholly misapplied to these birds. They are wholly useful.

285. (727.) *SITTA CAROLINENSIS* Lath. 17.

White-breasted Nuthatch.

Synonyms: White-bellied Nuthatch, Carolina Nuthatch. Kirtland, Ohio Geol. Surv., 1838, 164.

All must know this interesting inhabitant of the trees, for he is common all the year everywhere in the state, coming into the parks and not infrequently building his nest there or in the shade trees along the streets. He may be found everywhere that trees grow, especially in winter. He is usually the first of the winter company to make his presence known in the woods. His habit of clinging and feeding head down on the trunk of a tree attracts attention to him at once.

The food of this bird is both insects and vegetable matter. The insects are such as inhabit the bark of trees, mostly, and the vegetable matter seems to be largely the beech-

nuts and the other small forest nuts and fruits. I have seen the nuthatch descend to the ground for weed seed and other tidbits which have fallen upon the snow. He also sometimes searches about the decaying stumps and about the roots of the trees. There is nothing in the statement that he is one of the "sapsuckers" and so injures trees. He is a very useful bird at all times.

286. (728.) *SITTA CANADENSIS* Linn. 18.

Red-breasted Nuthatch.

Synonyms: Red-bellied Nuthatch, Canada Nuthatch.

Kirtland, Ohio Geol. Surv., 1838, 164.

This nuthatch is usually less common than the preceding, and is not resident anywhere in the state. It is more common as a migrant both spring and autumn, but it winters in small numbers over the entire state, more numerous in the southwestern part. It is found in nearly the same situations as the White-breasted, and frequently ranges with it. Its food seems to be much the same.

In its migrations it reaches the state early in April and is gone north by the middle of May, returning again about the middle of September. Most have gone south again a month later, a few remaining all winter.

Subfamily PARIDÆ. Titmice.

Of the members of this group which live in Ohio one is southern, scarcely reaching even the middle of the state. The other two are among the most common winter birds, the Chickadee often feeding about our houses. The Tufted Titmouse not infrequently comes into town, especially during March and April, when he is calling lustily. A whistled imitation of their calls will almost invariably bring one or more within reach of your hand. They are not so much in evidence in summer because they are busy with household affairs then.

287. (731.) *BÆOLOPHUS BICOLOR* Linn. 14.

Tufted Titmouse.

Synonyms: *Lophophanes bicolor*.

Crested Titmouse, Toupet Titmouse, Peter-peter, Sugar-bird.

Kirtland, Ohio Geol. Surv., 1838, 164.

This Titmouse is common all the year over the entire state. Its loud voice and unwariness make it a familiar woodland object. It also ventures into town during the winter and early spring, but keeps mostly to the woods. In winter it forms one of the company of small birds which range through the timber.

Its food consists of both animal and vegetable matter. The animal food is largely insects and the vegetable weed seeds and small nuts. It is at all times a useful bird.

288. (735.) *PARUS ATRICAPILLUS* Linn. 15.

Chickadee.

Synonyms: Black-capped Chickadee, Eastern Chickadee, Black-capped Titmouse, Black-cap.

Kirtland, Ohio Geol. Surv., 1838, 164.

There is hardly a more familiar bird in the state than either this more northern Chickadee or the next species. It comes into the dooryard during the winter, looking for any chance crumb, or for the suet which you may have thrown out or tied to some convenient tree. It generally retires to the woods at nesting-time, and is little seen then, but a whistled imitation of the *pe te* call will usually bring an answer and the bird himself after a little. The Chickadee is one of the most inquisitive of birds, and can readily be taught to feed from one's hand. It is well worth while to take a little time to cultivate the acquaintance of the birds which are sure to visit your yard at some time during the winter, for once they find provisions put out for them they become regular visitors, and soon call other birds to the feast. A bone not too closely picked, tied to a tree or nailed to a board placed convenient to the window, will do very well. They are also fond of suet, and broken nut meats are eagerly taken.

The food of this smaller titmouse is not unlike that of the Tufted. The Chickadee is probably a greater weed-seed destroyer.

289. (736.) *PARUS CAROLINENSIS* Aud. 16.
Carolina Chickadee.

Synonyms: *Parus atricapillus* var. *carolinensis*.

Southern Chickadee, Carolina Titmouse.

Wheaton, Ohio Agri. Report, 1874, 562.

It is difficult to distinguish between the two Chickadees at first, but one soon learns to note the smaller size of the Carolina. The notes and calls are also different, being higher pitched and more rapidly given than the Chickadee of the poets, and usually of more syllables.

The distribution of this Chickadee is not clearly worked out for Ohio. It is the more common form south, but does not appear to displace the other anywhere. The evidence seems to point to a more northerly distribution in the western part of the state, where it is known as far north as Columbus and Granville, but it seems to be absent from Morgan county and east of there. We need to study the chickadees more carefully before any definite statement can be made of the distribution of this form.

Family SYLVIIDÆ. Kinglets and Gnatcatchers.

Next to the hummingbirds these are the smallest of our native birds. They are strictly arboreal, but sometimes glean from the ground. In their passage north and south the kinglets feed plentifully in our orchards and shade trees, only the Gnatcatcher remaining to nest.

Subfamily REGULINÆ. Kinglets.

290. (748.) *REGULUS SATRAPA* Licht. 13.
Golden-crowned Kinglet.

Synonyms: *Regulus cristatus*, *R. tricolor*.

Golden-crested Kinglet, American Golden-crested Kinglet,
Fiery-crowned Wren.

Kirtland, Ohio Geol. Surv., 1838, 163.

This kinglet is common as a transient, but less common as a winter resident. It is sometimes even abundant during the migrations in certain localities. The kinglets are leaf and twig gleaners, but also make sallies after flying insects. They are to be found among the evergreen trees during the winter more often than elsewhere, but also frequent well protected brushy woods to feed. Their food seems to be wholly insects.

This kinglet goes north about the middle of April and returns again about the first of October.

291. (749.) *REGULUS CALENDULA* (Linn.). 12.

Ruby-crowned Kinglet.

Synonyms: *Motacilla calendula*.

Ruby-crown, Ruby-crowned Wren, Ruby-crowned Warbler. Kirtland, Ohio Geol. Surv., 1838, 163, 183.

The Ruby-crowned Kinglet is rather more common during its migrations than the Golden-crowned, but it does not remain during the winter, nor is there any record of its breeding within the state. It is found in the same situations as the Golden-crowned, both appearing in our parks and orchards in spring and autumn. The Ruby-crowned has a louder voice than its cousin, and may be more readily found on that account. The food is the same as that of the other species.

This kinglet reaches Ohio about the middle of April and remains four weeks, returning about October 1 and passing south in about three weeks.

Subfamily POLIPTILINÆ. Gnatcatchers.

292. (751.) *POLIPOTILA CÆRULEA* (Linn.). 11.

Blue-gray Gnatcatcher.

Synonyms: *Sylvia cærulea*, *Sylvania cærulea*, *Motacilla cærulea*.

Blue-gray Flycatcher, Little Blue-gray Flycatcher.

Kirtland, Ohio Geol. Surv., 1838, 163.

The Gnatcatcher is a fairly common summer resident in many localities, but less common in others. It is found in

brushy woods, nesting well up in the trees. It is so unwary that a near approach is easy, even if the birds do not come near to inspect you. The delicate little song carries well and must arrest the attention of the unobserving. As the name suggests, it feeds upon flying insects, but also gleans from leaves and branches.

One might expect so small and apparently delicate a bird to tarry in the south late, but it reaches Lorain county as early as the first week in April in favorable seasons. It apparently passes south again late in September, but autumn records are not wholly satisfactory.

Family TURDIDÆ. Thrushes, Robins, Bluebirds.

The Thrushes have been placed at the top of the bird branch because of their musical ability. It does not seem likely that they will remain there long, because their structure pretty clearly points to a lower place. But wherever they may finally rest in classification they will never cease to attract the earnest attention of all those who love good bird music. Added to this æsthetic value of the thrushes, there is their undoubted usefulness economically. For the most part they are woods birds, but during the migrations most of them may be seen in the shade trees or in the back yards which have been left bushy. Robin and Bluebird are too familiar to call for any remarks of mine. They need no added encouragement to live with us, but with a little encouragement the Wood Thrush, that "Nightingale of America," may easily be induced to make its nest in the back orchard, from whence he will give you a charming serenade twice each day during the summer season.

293. (755.) *HYLOCICHLA MUSTELINA* (Gmel.) 1.
Wood Thrush.

Synonyms: *Turdus mustelinus*.

Wood Robin, Wood Nightingale, American Song Thrush, Song Thrush.

Kirtland, Ohio Geol. Surv., 1838, 163.

The Wood Thrush is a common summer bird in all parts of the state. It announces its arrival with a burst of song, and may be heard singing well into August. Brushy woods or small second growth seem to be preferred for nesting-places. It is not so much a bird of thorny tangles as the Catbird, preferring a growth of young trees. Some make their way into the towns and villages, nesting in the orchards and berry patches in back lots. During the summer of 1902, a pair successfully reared a brood within five rods of the Chapel building on the Oberlin campus.

The food of this thrush is very largely such insects and worms as may be found on the ground among the leaves. It has not been accused of eating either fruit or garden vegetables. Its beautiful song adds to its usefulness a charm which every true bird lover cannot but wish to make a part of his summer life.

Wood Thrush comes to Ohio during the last days of April and remains well into September, but is silent during the last weeks of its stay.

294. (756.) *HYLOCICHLA FUSCESCENS* (Steph.). 2.
Wilson Thrush.

Synonyms: *Turdus fuscescens*, *T. wilsonii*.

Veery, Tawny Thrush, Nightingale.

Kirtland, Ohio Geol. Surv., 1838, 163.

The Veery is much less common than the Wood Thrush, but during the migrations may be fairly common. Occasionally a few remain to breed even south to our southern border. In the northern tier of counties it is regularly found all summer, but in small numbers. Its vocal powers are of an entirely different order from the Wood Thrush, being rather weird than beautiful. It lives in close company with the Wood Thrush, apparently nesting in much the same localities. The food habits do not seem to be materially different.

Wilson Thrush is usually a few days later than the Wood Thrush, in spring, and departs a little earlier.

295. (757.) *HYLOCICHLA ALICIÆ* (Baird). 3.
Gray-cheeked Thrush.

Synonyms: *Turdus swainsoni* var. *aliciæ*, *T. aliciæ*.

Alice's Thrush.

Baird, Rev. N. Am. Birds, 1864, 23.

Dr. Wheaton records this thrush as a "Common spring and fall migrant." It has been universally reported as a rare migrant. I have no doubt that closer acquaintance with it will prove it to be less rare. It is not easy to distinguish between this and the next species. I have found it only in the brushy woods in company with the Olive-backed. It appears to keep closer to the woods than the Olive-backed, feeding there on or near the ground. Its food probably consists of insects and worms largely.

Migration records are not satisfactory. Lorain county dates fall close to May 10, which is apparently near the end of the spring migration. I have no autumn dates.

296. (758a.) *HYLOCICHLA SWAINSONI* (Cab.). 4.
Olive-backed Thrush.

Synonyms: *Turdus swainsoni*.

Swainson's Thrush, Little Thrush, Swamp Robin.

Wheaton, Ohio Agri. Report, 1860 (1861), 379, hypothetical, Reprint, 5.

"Abundant migrant" characterizes this species in a few localities, as it apparently did for Columbus, at least when Dr. Wheaton was working. At most localities it is only common. This thrush is often seen in the parks and shade trees during its migration, where I have seen it feeding upon the tender shoots of trees, probably the young buds of the elms. Rev. Mr. Henninger found it eating gum berries in September. Its food must consist of insects captured on the ground or in trees indifferently. I have often seen it making sallies after flying insects, much after the manner of the flycatchers.

This thrush appears at Oberlin during the last five days of April and has gone north by May 23. It returns early in September and tarries about four weeks.

297. (759b.) *HYLOCICHLA GUTTATA PALLASII* (Cab.). 5.
Hermit Thrush.

Synonyms: *Hylocichla unalascae pallasi*, *Turdus pallasi*, *T. minor*, *T. solitarius*, *T. aonalaschkæ pallasii*.

Solitary Thrush, Rufous-tailed Thrush, Eastern Hermit Thrush, Swamp Robin, Ground Swamp Robin.

Kirtland, Ohio Geol. Surv., 1838, 163.

This thrush must be looked for early in April or late in March, and for that reason may be overlooked by many students of the migrations. It remains in the deeper woods during its stay, and is usually silent. I have heard it sing on only one occasion. Dr. Langdon reports the breeding of this species in the vicinity of Cincinnati, on the authority of Mr. Charles Dury. It appears to be the only breeding record for the state.

The food habits do not seem to differ materially from those of the other thrushes, except that it is found earlier and does not venture into our parks and gardens.

As suggested above, this thrush arrives early in April, usually departing about the time the other thrushes arrive. It returns in October and is present but a short time.

298. (761.) *MERULA MIGRATORIA* (Linn.). 6.
American Robin.

Synonyms: *Turdus migratorius*.

Robin, Robin Redbreast, Migratory Thrush, Red-breasted Thrush.

Kirtland, Ohio Geol. Surv., 1838, 163.

Robin is a common resident in the southern counties, much less common in the middle parts and rare as a resident in the northern counties in favorable situations. As a summer resident it is abundant from the middle of the state north, but less so south. While a few individuals remain all winter well north it should be regarded as a spring arrival and summer resident there. During the breeding season it is to be found everywhere except in the deep woods and swamps. During the molting season it retires to the deep woods in some numbers, but many still remain about

our lawns. It roosts at night with the blackbirds in considerable numbers, or forms roosts of its own.

The food of the Robin is varied according to the season largely. Prof. F. E. L. Beal has made a careful study of the food of this bird and it is worth while quoting extensively from his report here.

"An examination of 330 stomachs shows that over 42 per cent. of its food is animal matter, principally insects, while the remainder is made up largely of small fruits and berries. Over 19 per cent. consists of beetles, about one-third of which are useful ground beetles, taken mostly in spring and fall when other insects are scarce. Grasshoppers make up about one-tenth of the whole food, but in August comprise over 30 per cent. Caterpillars comprise about 6 per cent., while the rest of the animal food, about 7 per cent., is made up of various insects, with a few spiders, snails and angle worms. All the grasshoppers, caterpillars and bugs, with a large proportion of the beetles, are injurious, and it is safe to say that noxious insects comprise more than one-third of the Robin's food.

"Vegetable food forms nearly 58 per cent. of the stomach contents, over 47 per cent. being wild fruits, and only a little more than 4 per cent. being possibly cultivated varieties. Cultivated fruits amounting to about 25 per cent. were found in the stomachs in June and July, but only a trifle in August. Wild fruit, on the contrary, is eaten in every month, and comprises a staple food during half the year.

"The depredations of the Robin seem to be confined to the smaller and earlier fruits, and few, if any, complaints have been made against it on the score of eating apples, peaches, pears, grapes, or even late cherries."

From this it appears that the Robin is one of our most useful birds and should be rigidly protected.

The Robin is one of the first birds to greet us in spring and among the last to depart south. Dates of arrival for Oberlin fall very nearly on the first of March. The last are seen about the middle of November. A few remain all winter even on the lake shore.

299. (766.) *SIALIA SIALIS* (Linn.). 10.
Bluebird.

Synonyms: *Saxicola sialis*, *Sialia wilsonii*, *Motacilla sialis*.

Eastern Bluebird, Blue Robin, Blue Redbreast, Blue Warbler, Cottage Warbler, Blue-backed Redbreast Warbler, Common Bluebird, Wilson's Bluebird, American Bluebird.

Kirtland, Ohio Geol. Surv., 1838, 163.

Bluebird is familiar to all who ever look at birds. Previous to that disastrous cold winter—1894-5—when the Bluebirds were all but exterminated in Kentucky and Tennessee, it was decidedly common all summer. Its recovery from that calamity has been steady and rapid until it has become common again. Previous to that time there were no records for its wintering in northern Ohio, but since then it is regularly found all winter in small numbers. The survivors were a hardier race which has pushed its range farther north. Bluebirds are found everywhere except in the deep woods during the breeding season. They easily adapt themselves to the changing conditions due to the settlement of the country, and readily breed in boxes erected for their use.

They feed to a small extent upon wild fruits and their seeds, but 76 per cent. of the food is animal, mostly noxious insects. There can be no question of the usefulness of Bluebird.

Robin and Bluebird arrive very near together, and tarry equally long into November. The Bluebird is considered the "Harbinger of Spring."

ACCIDENTAL.

The species classed under this head are such as have wandered into the state from regions considerably removed which they regularly inhabit at some time of year. Their presence in the state cannot be accounted for in any other way than by supposing that some accident is responsible for their appearance in a place so far removed from their regular habitat, and therefore they cannot be expected to occur again under normal conditions.

ORDER PYGOPODES. Diving Birds.

Family ALCIDÆ. Auks, Murres, and Puffins.

The only representative of this salt-water inhabiting family is the Brünnich Murre, which was probably blown across Canada by a severe northeast storm. It is accidental in the state, and so would not figure in the economy of the state.

1. (31.) *URIA LOMVIA* (Linn.). —.
Brünnich Murre.

Butler, reported by E. L. Moseley as occurring at Sandusky on Lake Erie, Auk, 1897, 198.

The records that have come to me of the capture of specimens of this species in Ohio are: Ashtabula 1, Lake 2, Lorain 4, Erie 3, and likely Ottawa counties, all during the last half of December, 1896. Fairport, December 18; Sandusky, December 19. The Lorain and Ashtabula records are given as late December, probably about Christmas. It is not unlikely that individuals of this large inland flight penetrated to some of the interior waters of this state, but if so, records are lacking.

A wanderer from the northeast.

ORDER TUBINARES. Tube-nosed Swimmers.

The order is represented by a single species, three individuals of which were probably blown inland by a severe southeast storm, reaching Cincinnati on the Ohio river. Being wholly accidental in the state, and unlikely to occur again except under similar conditions, the species does not figure economically.

Family PROCELLARIIDÆ. Petrels, etc.

2. (98.) *ÆSTRELATA HASITATA* (Kuhl.). —.
Black-capped Petrel.

Synonym: *Procellaria hasitata*.

Lindahl, Auk, XVI, 1899, 75.

This reference may not be earlier than the Seventh Annual Report, Ohio State Academy Sciences, 56, same author, but absence of a specific date in that publication makes the above reference take precedence.

Two specimens were taken alive on October 5, 1898, on the Ohio shore, and one on October 4, the preceding day, on the Kentucky shore. All died in captivity and found their way into the collection of the Cin. Soc. Nat. Hist. All were in a starved condition, and therefore easily captured. Dr. Lindahl says that a severe northeast storm probably drove them inland.

Accidental from the east.

ORDER STEGANOPODES. Totipalmate Birds.

Family FREGATIDÆ. Man-o'-War Bird.

But a single specimen of the single species comprising this family has been taken in the state, reference to which is given under the species.

3. (128.) *FREGATA AQUILA* Linn. —.
Man-o'-War Bird.

Synonyms: *Pelecanus aquilus*, *Tachypetes aquilus*.

Frigate, Frigate Pelican, Hurricane Bird.

Davie, Nests and Eggs of N. Am. Birds, 1898, 74.

The single specimen for Ohio, according to Oliver Davie, in the above reference, "is now in the possession of Dr. Renshaw, of Sugar Grove, Ohio, and was taken by Mr. Emmet Adcock, in Fairfield county, Ohio, in the spring of 1880."

ORDER ANSERES. Ducks, Geese, Swans.

Subfamily ANATINÆ.

4. (136.) MARECA PENELOPE (Linn.). —.
Widgeon.

Synonyms: *Anas penelope*.

European Widgeon.

Jones, *The Wilson Bulletin*, 1902, 71.

The specimen here recorded was captured on the Licking reservoir, March 29, 1902, by Mr. Peter Hayden, of Columbus. The specimen was given to Mr. Irving A. Field who mounted it for the museum of Dennison University, Granville, Ohio, who reported this and another specimen captured there April 1.

Accidental from the east.

5. (141.) QUERQUEDULA CYANOPTERA (Vieill.). —.
Cinnamon Teal.

Synonyms: *Anas cyanoptera*.

Davie, *Nests and Eggs of N. Am. Birds*, 1898, 81.

"On the 4th of April, 1895, a fine male of this species was killed at the Licking county reservoir, by William Harlow." The specimen is now in Mr. Davie's private collection.

A wanderer from the west.

ORDER HERODIONES. Bitterns, Herons, Storks,
Ibises, Egrets.

SUBORDER IBIDES. Spoonbills and Ibises.

Family IBIDIDÆ. Ibises.

A single species of this family rarely wanders north to Ohio.

6. (186.) *PLEGADIS AUTUMNALIS* (Hasselq.). 193.
Glossy Ibis.

Synonyms: *Plegadis falcinellus*, *Ibis ordii*, *Ibis falcinellis*, *Ibis falcinellus* var. *ordii*, *Tringa autumnalis*.

Black Snipe, Black Curlew.

Dr. Wheaton records the only specimen of this species which has ever been taken in Ohio, as follows: "Dr. Kirtland, after quoting from the Boston Traveler (June 28), 1850, an account of the capture of this species at Cambridge and Middleboro, Massachusetts, and Middletown, Connecticut, says: 'To the above we would add that two of these interesting birds, probably a pair, were seen two years since near Fairport, Lake county. One of them, a beautiful male, was shot by Mr. Pruden, and forwarded to us. It was duly skinned and mounted, and may now be seen alongside of a Scarlet Ibis, from the banks of the Amazon, in the second case south of the door, in the cabinet of Nat. Hist., at Cleve. Med. Col.' "

A wanderer from the south.

ORDER PALUDICOLÆ. Cranes, Rails, etc.

Family GRUIDÆ. Cranes.

7. (205.) *GRUS CANADENSIS* (Linn.). —.
Little Brown Crane.

Synonyms: *Ardea canadensis*.

Davie, Nests and Eggs of North American Birds, Fifth Edition, 1898, 121.

"I mounted a specimen of this bird which was taken in the spring of 1884, from a flock of seven or eight birds near Springfield, Ohio. It is a rare migrant in the state." This is the only state record, and must be regarded as strictly accidental. It is not given by Butler as a bird of Indiana, and is regarded as a doubtful species in northern Michigan.

A wanderer from the west.

ORDER LIMICOLÆ. Shore Birds.

Family SCOLOPACIDÆ. Snipes, Sandpipers, etc.

8. (260.) PAVONCELLA PUGNAX (Linn.). [219.]
Ruff.

Synonyms: *Machetes pugnax*, *Trigna pugnax*, *Philomacus pugnax*.

Reeve, *Combatant*, *Gambetta*.

Wheaton, *Bull. Nuttall Orn. Club*, II, 1877, 83.

The above citation is of a specimen obtained by Dr. Theodore Jasper, at Licking reservoir, November 10, 1872. Rev. W. L. Dawson informs me that there is another specimen in the collection of the Ohio State University bearing date of April 28, 1878, taken at Columbus.

The credit for the preservation and final identification of the first specimen belongs to Dr. Wheaton.

A wanderer from the east.

ORDER RAPTORES. Birds of Prey.

Family FALCONIDÆ. Hawks, etc.

9. (337b.) BUTEO BOREALIS CALURUS (Cass.). —.
Western Red-tail.

Synonyms: *Buteo calurus*.

Black Red-tail.

A specimen in the collection of the Ohio State University proves to belong to this form. It was captured November 20, 1875, by Theodore Jasper, presumably near Columbus, since it is labeled "Franklin Co." in Dr. Jasper's handwriting. It is labeled a female.

ORDER PICI. Woodpeckers.

Family PICIDÆ.

10. (395.) DRYOBATES BOREALIS (Vieill.). —.
Red-cockaded Woodpecker.

Synonyms: *Picus borealis*.

Pine-bark Woodpecker. "Sapsucker."

A specimen in the Ohio State University collection bears the following inscription: "Picus borealis. March 15, 1872. Loc. Columbus, O. It was in company with another of its own kind and 2 or 3 sapsuckers, nuthatches, etc., and shot from a high tree between the canal and Scioto river." It proves to be a typical specimen of this species.

ORDER PASSERES. Perching Birds.

Family TYRANNIDÆ. Flycatchers.

11. (443.) MUSCIVORA FORFICATA (Gmel.). —.
Scissor-tailed Flycatcher.

Synonyms: *Muscicapa forficata*, *Milvulus forficatus*.

"Fork-tailed Flycatcher," Swallow-tailed Flycatcher.

Davie, Nests and Eggs of North American Birds, Fifth Edition, 1898, 297.

"A male specimen of the Scissor-tailed Flycatcher was taken near Marietta, O., May 20, 1894, by Mr. Frank H. Welder, the skin of which is now in his collection."

A wanderer from the southwest.

Family ICTERIDÆ. Blackbirds, etc.

12. (497.) XANTHOCEPHALUS XANTHOCEPHALUS .
(Bonap.). [116.]
Yellow-headed Blackbird.

Synonyms: *Xanthocephalus icterocephalus*, *Icterus xanthocephalus*.

Wheaton, Ohio Agri. Report, 1874, 567. Mentioned by Coues, Birds N. W. as probable in Ohio.

There is a specimen in the collection of F. Frey, of Sandusky. A flock of six passed over Oberlin just above the treetops, October 9, 1896.

One is reported from McConnellsville, Morgan county, by Mr. E. J. Arrick.

These, with the statement of Dr. Wheaton that a pair was seen by Mr. W. R. Limpert, in the summer of 1873, near Groveport, Franklin county, exhaust the Ohio records that I have been able to find.

A wanderer from the west.

Family FRINGILLIDÆ. Sparrows, etc.

13. (553.) ZONOTRICHIA QUERULA (Nutt.). —.
Harris Sparrow.

Synonyms: *Fringilla querula*.

Hooded Crown Sparrow, Black-hood Sparrow.

Davie, Nests and Eggs of N. Am. Birds, 1898, 337.

"On the 29th of April, 1889, Mr. J. E. Gould shot a specimen of Harris Sparrow two miles north of Columbus, Ohio. Four or five others were observed feeding in a thicket in company with the White-throated Sparrow, *Z. albicollis*." The specimen was presented to Mr. Davie, and his identification corroborated by Mr. C. F. Batchelder. The skin is now in the collection of the Ohio State University. This small group must have wandered far out of their way in the northward migration.

A wanderer from the west.

Family MNIOTILTIDÆ. Wood Warblers.

14. (672a.) DENDROICA PALMARUM HYPOCHRYSEA
Ridgw. —.
Yellow Palm Warbler.

McCormick, Auk, IX, 1892, 397.

This specimen, captured on April 10 (not 16 as in the Auk, 1892), remains the only record for the state. It was taken by Mr. G. D. Wilder, at Oberlin.

A wanderer from the east.

Family PARIDÆ. Titmice, etc.

15. (729.) SITTA PUSILLA Lath. [19.]
Brown-headed Nuthatch.

Kirtland, Ohio Geol. Surv., 1838, 164, 183.

Dr. Kirtland's statement, "I once killed a specimen in the northern part of the state," remains the only instance of its occurrence within our limits.

INTRODUCED.

Of the four species which have been introduced into Ohio but two are to be found now. The English Sparrow has become not only a nuisance, but a menace to the balance of nature between the insects and those birds which feed upon insects, by crowding the native birds out in many instances. It is not at all certain that the Mongolian or Ring-necked Pheasant may not, ere long, also prove a menace to the agricultural interests by a too great increase in numbers. Happily the other two foreign species were unable to gain a foothold in our state. They might not have proved injurious if they had succeeded in becoming acclimatized, but it is never safe to make predictions. Recent legislation forbids the importation of other birds and mammals into the United States except under proper supervision. It is not likely that we shall have to learn over again the folly of precipitate action of this sort.

ORDER GALLINÆ.

Family PHASIANIDÆ.

1. PHASIANUS TORQUATUS.

Ring-necked Pheasant.

Synonyms: Mongolian Pheasant.

Successfully introduced into Allen, Ashtabula, Crawford, Erie, Hamilton, Hardin, Madison, Morgan, Scioto, and Summit counties, and probably others.

ORDER PASSERES.

Family FRINGILLIDÆ.

2. PASSER DOMESTICUS (Linn.). [unnumbered.]

English Sparrow.

Synonyms: *Pyrgita domestica*, *Fringilla domestica*.

European House Sparrow, Philip Sparrow, Parasite Gamin, Hoodlum, Tramp, The Sparrow.

Wheaton, Ohio Agri. Report, 1874, 566.

The first importation of this pest into the state directly from Europe was into Cleveland, in 1869, twenty pairs. During the same year thirty-three pairs were taken from New York to Cincinnati and Warren. Then followed importations into Marietta, 1870, Coshocton and Portsmouth, 1874, Steubenville, about 1880 or 1881, Wapakoneta, about 1882, which seems to have been the last importation. Since that time it has spread well over the state, in the more settled districts, even invading the country places and farm buildings, until the tendency to nest in the woods grows strong. About Oberlin several pairs have already invaded the trees rightfully belonging to Bluebirds and Crested Flycatchers, in the woods a mile from the village.

EXTINCT.

But two native and two introduced species have become extinct in historic times. At least three others are rapidly approaching extinction: these are Wild Turkey, Passenger Pigeon, and Swallow-tailed Kite. It was supposed that these would prove extinct, but records of occurrence within the past ten years make it necessary to retain them for the present. The causes for the disappearance of these two native birds and the great decrease of the others are not far to seek. They have been mercilessly hunted and their natural breeding places have been destroyed in the settlement of the state. Lacking the ability to change their habits with the changing conditions, it was inevitable that they should die out.

ORDER GALLINÆ.

Subfamily TETRAONINÆ.

1. (305.) *TYMPANUCHUS AMERICANUS* (Reich.). 183.
Prairie Hen.

Synonyms: *Cupidonia cupido*, *C. americanus*, *Tetrao cupido*.
Pinnated Grouse, Prairie Chicken.

The last trace I have been able to find of the presence of this bird in the state is that of Prof. E. L. Moseley, who reports a capture in 1880, near Sandusky. It is now extinct within the state.

Apparently this bird has always been confined to the northwestern prairies of the state, and can hardly have been common at any time within the history of the state as a state.

ORDER PSITTACI. Parrots.

The single species representing this order in Ohio is now extinct in the state

Family PSITTACIDÆ. Parrots and Paroquets.

2. (382.) CONURUS CAROLINENSIS (Linn.). Carolina Paroquet.

Synonyms: *Psittacus carolinensis*.

Orange-headed Parrot, Carolina Parakeet, Carolina Parrot, Parakeet, Illinois Parrot.

Wilson, *Am. Orn.*, III, 1811, 89.

It is probably true that this almost extinct species was an inhabitant of the larger part of Ohio during the first decade of the 19th century and previously, reaching Lake Erie at its western end at least. In 1831 Audubon remarked upon the rapid decline in numbers. Later than that the birds were largely confined to the southwest corner of the state, occurring in small and scattered flocks as far north as Summit county up to 1853. "In July, 1862, a flock numbering from twenty-five to thirty made their appearance in the Capitol Square of Columbus," remaining a couple of hours in the elm trees in front of the residence of Wm. S. Sullivan, LL.D., who reported this occurrence to Dr. Wheaton.

Mr. Oliver Davie says: "The last record we have of this bird being taken in Ohio is October 9, 1884. A specimen was shot by Mr. A. Lee Hoskinson, near Newark, and mounted by S. G. Hamilton. . . . It is still in Mr. Hoskin-

son's possession." It is not impossible that this was an escaped cage-bird.

There can be no doubt that this belongs to the extinct species of the state.

ORDER PASSERES. Perching Birds.

Family ALAUDIDÆ. Larks.

3. (473.) *ALAUDA ARVENSIS* Linn. [unnumbered]
Skylark.

Synonym: European Skylark.

Langdon, Journal Cin. Soc. Nat. Hist., I, 1878, 111.

The first attempt to introduce this European species into the state was by a Mr. Bateham in the autumn of 1851, when a cage of them was liberated in the grove back of the Lunatic Asylum, Cincinnati. Colonel Harris stated that these shortly disappeared. Another more successful attempt seems to have been made during the seventies, since Dr. Langdon, in his list of 1878, states that they had been found breeding in the outskirts of Cincinnati. This colony must have disappeared shortly after Dr. Langdon's list was published, for nothing more was known about them when Dr. Wheaton published his catalogue in 1882. Skylarks are unknown in the state now.

Family FRINGILLIDÆ. Sparrows, etc.

4. *CARDUELIS CARDUELIS* (Linn.). —.
Goldfinch.

Synonyms: *Fringilla carduelis*.

European Goldfinch, Thistlefinch.

Langdon, Journal Cin. Soc. Nat. Hist., IV, 1881, 342.

Introduced at Cincinnati during the years 1872-4. Apparently they did not thrive, since nothing has been heard from them since their introduction.

HYPOTHETICAL.

The species included under this head are mostly those whose known range should cover Ohio either during their migrations or during their regular wanderings, but which have not yet been found in the state. Two of the species are here placed because they are regarded as hypothetical forms in the United States. The Cincinnati Warbler is still represented by a single specimen, and Brewster Warbler has not yet been given the distinction of a sub-specific rank. It will probably be some time before the question of hybridism as applying to these two forms is settled. I have deemed it wise to place here some species included in Dr. Wheaton's catalogue on what appears now to be insufficient evidence. It is not enough to say that a species is or has been found; the statement must always be verified by specimens where the species is at all rare. No record should be allowed to stand unquestioned without the evidence of a specimen to prove that the species has occurred within the state.

1. (38.) STERCORARIUS LONGICAUDUS Vieill.
Long-tailed Jaeger.

This Jaeger may pass across the state in its migrations.

2. (40.) RISSA TRIDACTYLA (Linn.). 273.
Kittiwake.

Synonyms: *Larus tridactylus*.

Common Kittiwake.

Wheaton, Ohio Agri. Report, 1860, 371, 379.

There are two records for Ohio. That of three specimens reported by Mr. R. K. Winslow in Cleveland harbor, clearly before the eighties, and the report of Mr. E. W. Vickers for Mahoning county. I am unable to find evidence of the preservation of specimens of this gull. The fact that it is regarded as rare or even doubtful as a winter visitor in Michigan, and has never been found in Indiana

nor in Pennsylvania, throws doubt upon any record not accompanied by specimens.

3. (42.) *LARUS GLAUCUS* Brünn.

Glaucous Gull.

Arctic regions, south in winter to the Great Lakes and Long Island.

4. (65.) *STERNA MAXIMA* Bodd.

Royal Tern.

Tropical America and warmer parts of North America, casually northward to Massachusetts, the Great Lakes and California.

5. (71.) *STERNA PARADISEA* Brünn.

Arctic Tern.

This tern should be found passing across the state during the migrations.

6. (120a.) *PHALACROCORAX DILOPHUS FLORIDANUS*
(Aud.). 272a.

Florida Cormorant.

Synonyms: *Graculus dilophus* var. *floridanus*, *G. floridanus*,
Phalacrocorax floridanus.

Water Turkey.

Wheaton, Ohio Agri. Report, 1874, 575.

The evidence that this form nested in considerable numbers at the St. Mary's reservoir prior to 1875, is not beyond question.

7. (155.) *HISTRIONICUS HISTRIONICUS* (Linn.).

Harlequin Duck.

Synonyms: *Anas histrionicus*, *Histrionicus torquatus*.

Admitted to Dr. Wheaton's list in error. It may be found in the state.

8. (166.) *OIDEMIA PERSPICILLATA* (Linn.).
Surf Scoter.

Synonyms: *Anas perspicillata*.

It is likely to be found on Lake Erie.

9. (173.) *BRANTA BERNICLA* (Linn.). 246.
Brant.

Synonyms: *Bernicla brenta*, *Anser bernicla*, *Anas bernicla*.
Brant Goose.

Kirtland, Preliminary Report, Ohio Geol. Surv., 1838, 67.

The lack of specimens from Ohio necessitates placing this goose on the list of Hypothetical species.

10. (191.1.) *ARDETTA NEOXENA* Cory.
Cory Least Bittern.

If this be a good species it should be found in Ohio as a migrant and probably also breeding. It has been found breeding in Ontario, hence its migration route must cross Ohio.

11. (222.) *CRYMOPHILUS FULICARUS* (Linn.). 226.
Red Phalarope.

Synonyms: *Phalaropus fulicarius*, *Tringa fulicaria*.
Coot-footed Tringa, Gray Phalarope.

Wheaton, Ohio Agri. Report, 1861, 380, hypothetical.

This published record is based upon the statement of Mr. R. K. Winslow, of Cleveland, "that two or three specimens had been taken on Lake Erie." There being no other record, and no specimens preserved, it seems necessary to place the species in the Hypothetical list.

12. (392.) *CAMPEPHILUS PRINCIPALIS* (Linn.).
Ivory-billed Woodpecker.

Synonym: *Picus principalis*.

White-billed Logcock, White-billed Woodcock.

The evidence of the probable former presence of this regal woodpecker in Ohio is strong. A specimen was taken

in Franklin county, Indiana, which borders Ohio. The map in the Auk, 1891, by Hasbrouck, illustrating the present and former range of this bird in the United States, is made to cover the extreme southwest corner of Ohio. We shall probably never have positive evidence of its occurrence in Ohio.

13. (466a.) *EMPIDOMAX TRAILLII* ALNORUM Brewst.
Alder Flycatcher.

Jones, Wilson Bulletin, No. 20, 1898, 37.

This subspecies was elaborated after Dr. Wheaton's time. While it has not been reported by any ornithologists in the state, there can be no reasonable doubt that it migrates across regularly. No doubt a critical examination of specimens in the local collections throughout the state will reveal specimens of this form now supposed to be *traillii*.

14. (597.) *GUIRACA CÆRULEA* (Linn.).
Blue Grosbeak.

Reported at College Hill, Cincinnati, June 12, 1899, by Laura Gano. No specimen was secured. It seems likely that it may occasionally reach our southwestern border.

15. (601.) *CYANOSPIZA CIRIS* (Linn.).
Painted Bunting.

Reported from Sandusky by Prof. E. L. Moseley. No specimen was secured. This record, if authentic, would seem to be a case of escaped cage-bird. It is likely that wanderers may sometimes reach the vicinity of Cincinnati.

16. (675a.) *SEIURUS NOVEBORACENSIS NOTABILIS*
(Ridgw.).
Grinnell Water-Thrush.

Synonyms: *Seiurus nævius notabilis*.

Having been found at Brookville, Indiana, not far from our western border, it is entirely possible that it may be found in the western part of the state.

17. (21.) *HELMINTHOPILA LEUCOBONCHIALIS* (Brewst.).
Brewster Warbler.

Synonym: *Helminthophaga leucobonchialis*.

Jones, Wilson Bulletin, No. 42, June 15, 1903, 68.

On May 23, 1902, while out with my class for early morning study, we discovered a singing male of this interesting form. The first part of the song was clearly Blue-wing in all particulars, while the last was just as clearly Golden-wing. The students noticed the oddity of the song without having their attention especially called to it. We studied the bird in all lights and positions for half an hour, many times within fifty feet, with a pair of stereo-binoculars, clearly making out the white underparts, faintly tinted with yellow on the breast and a slight darkening of the chin feathers, the yellow crown and great yellow wing patch. On the 28th we again found the bird in the same situation, on the border of an open woods, and gave it even more attention than before. It was in full song, and seemed less wary than before. A week later it was gone. The evidence of nesting seemed so strong that I was unwilling to collect the bird, hoping to secure a breeding record and be able to study the hybrid family. The bird was probably not strictly typical *leucobonchialis*, but came near to it, as indicated by both song and plumage.

During the spring of 1903 two almost typical specimens have been secured and at least one other seems to be tarrying to nest in a woods half a mile west of Oberlin. I am hoping to add some direct testimony to the life history of this interesting variation.

18. (22.) *HELMINTHOPILA CININNATIENSIS* (Langd.).
31.
Cinnati Warbler.

Synonym. *Helminthophaga cinnatiensis*.

Langdon, Journal Cin. Soc. Nat. Hist., III, 1880, 119.

The single specimen collected by Dr. Langdon, May 1, 1880, at Madisonville, from which his description was

made, remains unique. In the absence of other specimens the theory of hybridism seems probable. If a hybrid it was probably between *H. pinus* and *G. formosa*. The formation of hybrids between *H. pinus* and some closely allied species seems not uncommon.

(371.) NYCTALA TENGMALMI RICHARDSONI (Bonap.).
Richardson Owl.

Synonyms: *Nyctale richardsoni*.

Tengmalm's Owl, Arctic American Saw-whet Owl, American Sparrow Owl.

Coues, Birds of N. W., 1874, 314.

There seems to be no question but this reference was an error.

SUMMARY.

More or less regularly found in the state.....	299
Accidental in the state.....	15
Imported from Europe.....	2
Extinct	4
Hypothetical on the A. O. U. Check-List.....	2

Whole number of species actually recorded in the state....	322
Hypothetical	16

Whole number of species treated in this Catalogue.....	338
Dr. J. M. Wheaton's Catalogue.....	298

BIBLIOGRAPHY OF OHIO ORNITHOLOGY

This bibliography includes that given by Dr. Wheaton, in a somewhat abbreviated form, and such other books, catalogues and periodicals as have appeared since 1882, which contain references to Ohio birds. It makes no pretensions to being a complete bibliography, but serves to show from what sources my information has been derived. Some references are of a decidedly general nature, others specific.

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Special Papers No. 7



Ecological Study of Big Spring Prairie Wyandot County, Ohio

By
THOMAS A. BONSER

Published by the Academy of Science
with the Emerson McMillin Research Fund.

COLUMBUS, OHIO

1903

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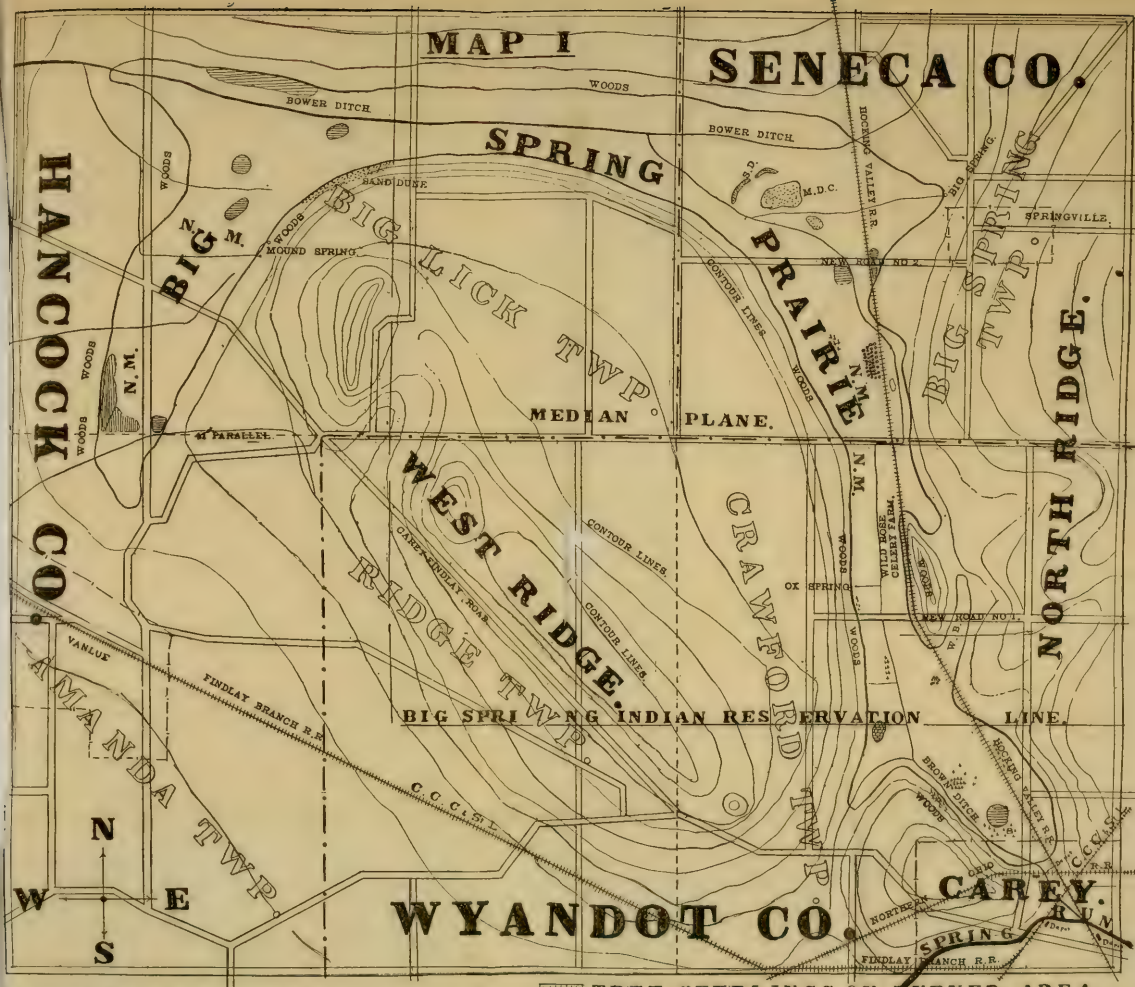
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OHIO STATE ACADEMY OF SCIENCE

SPECIAL PAPERS No. 7

ECOLOGICAL STUDY OF BIG SPRING PRAIRIE

WYANDOT COUNTY, OHIO,

BY

THOMAS A. BONSER

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Publication Committee:

J. H. SCHAFFNER L. H. McFADDEN GERARD FOWKE

COLUMBUS, OHIO
1903

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WILLIAM R. LAZENBY,

F. M. WEBSTER,

JOHN H. SCHAFFNER,

Trustees.

INTRODUCTION.

In the Autumn of 1899, the writer began the ecological study of Big Spring Prairie, situated in Wyandot, Seneca, and Hancock counties, Ohio. This prairie is about ten miles long, and from one half to a mile wide. From its shape, it might aptly have been termed Horse-shoe Prairie. It originates just north of Carey, in fact a portion of it lies within the corporate limits of the town; thence it extends four miles in a northwesterly direction; here, making a sweeping curve, it extends three miles westward; again widely curving, it extends three miles in a southwesterly direction, ending about one-half mile north of Vanlue, Hancock county. About two and one half miles of prairie lie in Wyandot county, about the same extent in Seneca county, and five miles in Hancock county. The widest portion occurs in Seneca county, where it curves to the westward, the next widest in Hancock county, where it curves to the southwest.

The term prairie has been applied to the more or less grassy plains of the treeless regions both east and west of the Mississippi River. The eastern prairies differ in many particulars besides size, from those in the extreme west near the foot of the Rockies. Between these limits, we may find all gradations in specific characteristics. The typical eastern prairies are properly natural meadows; some, in fact, border on the semi-marsh type. This belt comprises the region from the eastern prairie limit to Missouri and Iowa. West of this there is a gradual gradation through the steppe type to the semi-desert near the Rockies.

The most striking differences between the eastern and western prairies are the climatic factors of rainfall and general humidity of the atmosphere.

The climatic factors of irregular and scanty rainfall and the general low humidity of the atmosphere are potent causes of the western type of prairie. These factors in combination with the occurrence of frequent prairie fires are sufficient to account for the absence of trees upon this type of prairie.

The origin, development, and future of the eastern type of prairie must be considered apart from the western type, as each possesses its own peculiar factors and specific characteristics. Prairies may be studied by a comparative survey of the likenesses and differences of the various types of prairie areas, and the causes which led to them. Again we may study each type comparatively with the topographic features and vegetative characteristics immediately surrounding it. This latter survey should be conducted along the border line of prairie and forest, where the struggle can be said to be fairly on, and where the effects and results of this rather uneven struggle can be most advantageously observed. A life-time is frequently long enough to observe the forest encroachment upon the eastern prairie, ages might be required to note the same degree of encroachment upon the western type of prairie.

Many theories have been advanced to account for the absence of trees on prairies; as the prairie fire theory; the fine soil theory; the ulmic acid theory; etc. Lesquereux states that prairies are formed from old lakes, or bays extending from them with the marsh as the intermediate formation, and he furthermore asserts in regards to these: "Trees never invade them, never grow upon them, even when drained." This latter statement may need some modification, as observation does not bear out the assertion "even when drained."

In the West, the prairie is the natural formation, the presence of the forest is especially to be explained.

In the East, the forest formation is the natural one, the presence of the prairie is to be explained. The

eastern prairie is only an intermediate formation between the marsh and the forest formation. It is simply a question of time. The observed facts corroborate this.

As it is difficult adequately to define tree, but much easier to define deciduous tree, still easier to define Cottonwood tree, and easiest to define *Populus grandidentata*; so it is difficult to announce principles, or elaborate a statement of facts which shall fully apply to all prairies in all conceivable localities, and under their various natural conditions, but easier to apply the same to the eastern prairie, still easier to the Ohio prairie, and easiest to apply certain well-defined principles, and give a statement of observed facts in regard to Big Spring Prairie. The last named task shall be ours chiefly in the following article. In accordance with the above, our investigations have been conducted along the following lines.

- (1) Geological formations surrounding prairie, and the characteristic vegetation of same.
- (2) Past condition of prairie, especially since 1832, in which year the Big Spring Indian Reservation was thrown open to settlement.
- (3) The drainage of prairie, past and present, and its effect upon general level of same and also upon the character of the vegetation.
- (4) The lagging behind of effects, as shown by the observed facts that plants cling for a time to a locality after the conditions have changed, in this instance from the hydrophytic to the mesophytic.
- (5) The nature of the soil in the various portions and the characteristic vegetation of same.
- (6) Tree introduction or encroachment upon prairie, the order and cause.
- (7) The prairie under cultivation.

The writer wishes to extend his thanks to Dr. H. C. Cowles, of the University of Chicago, under whose direction the investigation of this area was conducted: and also to Prof. W. A. Kellerman, Ph. D., of the Ohio State University, for some of the photographs, and for his personal visits to the area and his kind assistance in various ways. The writer is also under obligation to Mr. W. C. Johnson, Mr. Peter Brayton, and Mr. H. B. Phelps for aid rendered or information furnished.

The principal factors which must be considered in prosecuting the lines of investigation indicated naturally divide themselves into Climatic, Physiographic, Historical, and Ecological.

CLIMATIC CONDITIONS.

Big Spring Prairie is crossed at two points by the forty-first parallel, which forms the boundary line between Wyandot and Seneca counties. By reference to Map 1, it will be seen that almost equal parts of this prairie lie on either side of this line. It is about forty miles south from Lake Erie and about twenty miles north from the Ohio River and Lake Erie divide. The extremes of temperature are slightly greater here than directly along the lake shore. This, in part, may account for some of the differences in vegetation of the Big Spring Prairie and the Castalia Prairie near Lake Erie. In the Spring, the vegetation which has begun active growth during a few premature warm days, is more likely to be injured by frost than the more tardy vegetative growth of the lake region. In the Autumn, frosts occur earlier than in the lake region. Furthermore, on the low lying prairie with its moist black soil, frosts occur later in Spring and earlier in Autumn than on the ridges around it.

1. PHYSIOGRAPHIC.—GEOLOGICAL FORMATIONS SURROUNDING PRAIRIE AND CHARACTERISTIC VEGETATION OF SAME.

The Niagara Limestone is the native rock which underlies the western part of Wyandot and Seneca counties and the eastern part of Hancock county. The surface of these counties is quite level, moderate hills occurring only along the larger natural water courses. As there are no important natural water courses in the vicinity of the Prairie, the country is a rather level plain with the exception of an interesting and remarkable outcrop of Niagara Limestone. This

outcrop occurs in the form of two ridges, one is designated "North Ridge," the other "West Ridge." Each is about five miles long, but the West Ridge is the longer of the two, and considerably broader than North Ridge. North Ridge originates about one-half mile north of Carey and extends northward for nearly five miles, where it almost imperceptibly merges into the general level of the country to the north of it. The greater portion of the steepest slope is toward the Big Spring Prairie on the west. This ridge is traversed by several gently sloping drainage valleys, which may have been preglacial gulleys, now filled with drift. For the depth to the underlying rock is considerably greater here than on the median plains which also occur on portions of both ridges.

The West Ridge originates a short distance west of the corporation line of Carey, Ohio, and extends over five miles in a northwesterly direction. The Carey and Findlay pike is situated either on the crest-line of the ridge, or near it. From an inspection of Map 1, it will be seen that the crest extends first northwestward, then turns sharply to the north. The steepest slope is toward the south and west, the outcrop being quite conspicuous at certain localities. To the northeast of the crest, the land slopes quite gradually and forms a rather level plain until within a short distance from the prairie, where it forms a short but decided slope to it. This ridge is also traversed, by those broad gently sloping drainage valleys, which are especially noted for their fertility.

The characteristic Niagara fossils have been found chiefly in the North Ridge. As there are no extensive perpendicular sections of the bedding, the dip of the strata can be judged only from the perpendicular exposures in the quarries on the slopes of the ridges. It is found that the dip is quite uniformly toward the low ground nearest to the quarry. The dip in the various

quarries varies from a gentle dip of 5° to as high as 18° . The ridges are perforated with numerous sink-holes and subterranean water channels, from one of which the Carey Water Works obtains its supply for the town.

The dip of the strata and the subterranean water supply have considerable bearing upon past and present conditions of prairie, as will be explained later. In the Ohio Geological report the following theory to account for those ridges occurs: "It would seem as if the conditions of the ocean's bed in which the Niagara was formed were not uniform. While regular strata were being deposited in a wide area, including portions of Seneca and Hancock Counties, without disturbance or contortions, a concretionary and crystallizing force sprang up into operation in the northwest corner of Wyandot County which in working from below, caused the even beds of deposition to swell upward over the growing mass or masses. In some cases it aided in the preservation of fossil remains. In others it hastened their absorption into the mass of rock. This is a peculiarity of the rock formation not confined to the Niagara, but is displayed conspicuously in the water-lime above, and it has been seen in the corniferous. When the lapse of time brings such hardened masses into contact with the erosions of ice and water, they cause the prominent features of the landscape by the removal of the more destructible parts about them. Such may be the explanation of the remarkable ridges about Carey, the even friable beds seen in the quarries about their flanks having once been continuous over their summits, but unable to resist the forces of the glacial epoch were denuded down to the more enduring rock."

Thus the summits of the ridges, which are comparatively narrow for the greater part of their extent consist of a very hard Niagara Limestone, while there is a gradual transition in hardness along the sides to the rather friable strata along or near the bases.

Along the summits and edges of the ridges, the soil, varying from dark red clay to lighter shades, is exceedingly thin, the fields being covered with angular stones.

In the shallow natural drainage courses, the soil is a rich loam, as it is also on the flat median plain of West Ridge. Along the base the soil is frequently quite sandy.

Whereas the greatest heights of both North and West Ridge are about one hundred and fifty feet each, and the median plains of same about thirty to fifty feet higher than prairie, the country to the north and west of the prairie is as a rule, only about three to six feet higher than the level along edge of prairie. Even this elevation is a gradual slope reaching this height at a distance of forty to eighty rods from the edge of prairie. Although this slope is so very gradual, only in a few localities is there a gradual transition from forest to prairie. For the greater portion of its extent, the line of demarkation between forest and prairie is quite distinct. Bordering upon the southwestern portion of the prairie, there is a low wet woods in which there is no perceptible difference in level between it and the adjoining prairie.

CHARACTERISTIC VEGETATION OF THE RIDGES.

For the sake of more clearly indicating the nature of the various plant societies in a more or less limited area, it will be found expedient to employ five classes of plant societies instead of the three given by Warming. The classes under this scheme would be :

- (1) Xerophytic area.
- (2) Xero-mesophytic area.
- (3) Mesophytic area.
- (4) Hydromesophytic area.
- (5) Hydrophytic area.

The first, third, and fifth conform to Warming's classes.

A xero-mesophytic area is one in which there is an approximately even mixture of the two classes from which the name is derived. The same applies to the term Hydromesophytic. This enables us to more clearly define the peculiar characteristics of limited areas, which would otherwise be impossible.

Furthermore these terms can be employed absolutely or relatively. Absolutely considered there are no extensive xerophytic plant societies in Ohio, as only the plants occurring on more or less perpendicular rock walls; on edges of cliffs, on the lower and middle beaches of Lake Erie; on the nearly perpendicular surfaces of freshly eroded river banks can be classed as such. Even in these cases the term applies rather to the hard condition of life and to the difficulty of gaining or maintaining a foothold than to the idea of drought-enduring as commonly understood. Relatively we can designate that society of any given region, which occurs under the most unfavorable conditions, relatively xerophytic, and those in the wettest, hydrophytic, and the gradations between them as before indicated. As the latter view is apt to lead to confusion, we shall confine ourselves to the former limitations, and accordingly consider the Xero-mesophytic as the extreme of plant society in the area under consideration. And even under this heading, we can bring only the summits of the ridges, the exposed slopes, and the evident outcrops of the Niagara limestone.

Both ridges were formerly densely wooded, but at present there are only a considerable number of small areas which can be termed woodlands, and even from these, the largest and most desirable timber trees have been removed.

Although the ridges as a whole exhibit a characteristic forest formation, yet this forest formation can be divided into two distinct types occurring respectively on:

(1) The summits, the exposed slopes, and the outcrops.

(2) The level median plane, and the broad shallow drainage valleys.

The differences to be considered are two-fold.

(1) Presence of species in one area not found in the other.

(2) Relative abundance of the same species in the two areas.

The type of plant society taken as a whole would be designated as White-oak, Black-oak, Hickory Forest, a term applied by Dr. H. C. Cowles, of the University of Chicago, to a similar type of forest formation at Glencoe, Illinois. At Glencoe, Illinois, this type occurs on hills of extensive drift formation, and in this region the same type in a pronounced form occurs on an outcrop or upheaval of Niagara Limestone, both representing the Xero-mesophytic form of plant society.

The soil on the summit of the ridges and along the steepest hillsides is quite shallow, consisting largely of red clay, although various other shades of clay also occur. The underlying rock seems to weather into a slightly sandy clay soil. Numerous sink holes, now filled up, formerly occurred on these ridges. These enabled the surface water to disappear readily, and retarded the progress of the plant societies upon it, thus partially accounting for the Xero-mesophytic forest type instead of the mesophytic type which sometimes occurs upon such areas as pointed out by Dr. H. C. Cowles in his "Plant Societies of Chicago and Vicinity." The history of the plant life on this area in the past most probably conformed in its main features to the account of the "Upland Series of Plant Societies" in the work referred to, but the type of forest had not as yet attained the possible mesophytic type.

In treating of the plant societies of any region, it is not necessary or even expedient to enumerate all the plants occurring in them. The rare or accidental ones are sometimes of interest only as they may be remnants of some past society or prophecies of some future one, generally difficult of interpretation. The common plants which give character to the landscape are the ones of most interest as they have proven their fitness of survival by their successful struggle with their rivals.

The divisions under which the plants of these ridges can be divided are the Woodland Societies, The Road-side Societies, the Cultivated Field Societies, and the Pasture-land Societies, the last two constituting the troublesome weeds. The Woodland societies of the summits of ridges, steep slopes, and outcrops shall be considered separately from those of the median plane and drainage valleys, while in regard to the remaining societies, it is not necessary to thus subdivide them.

The plants of the woodland areas are conveniently arranged under the horizontal strata of trees, shrubs, and herbs. The forests on the summits of the ridges, the steepest slopes, and the outcrops of the Niagara limestone are xeromesophytic and of the White-oak, Black-oak, Hickory type of forest.

Considerably over one-half of the trees are species of *Quercus* (Oak), less than one-fourth are *Hicoria* (Hickories), the remainder are a variable mixture of *Cornus* (Dogwood), *Cercis* (Redbud), *Sassafras* (Sassafras), *Acer* (Maple), *Crataegus* (Hawthorn), *Juglans* (Walnut) *Celtis* (Hackberry), and *Ostrya* (Ironwood). Of the latter the dogwood and redbud are perhaps the more abundant, the walnut the least abundant.

The most characteristic tree is *Quercus alba* L. (White oak). The next most common ones of the oaks are *Quercus rubra* L. (Red oak) and *Quercus velutina* Lam. (Black oak). Besides these, the following occur: *Quercus minor* (Marsh), Sarg. (Post or iron oak),

Quercus imbricaria Michx (*Shingle oak*), and *Quercus acuminata*, (Michx) Sarg. (*Chestnut or yellow oak*), doubtless also a number of hybrids.

The second most characteristic tree is *Hicoria ovata* (Mill) Britton (*Shell-bark Hickory*), other common species are *Hicoria alba* (L.) Britton (*White-heart hickory*) and *Hicoria glabra* (Mill) Britton (*Pignut hickory*).

The following species constitute the remaining minority of individuals:

Cornus florida (L.) (*Flowering dogwood*), *Celtis occidentalis* (L.) (*Hackberry*), *Prunus pennsylvanica* L. f. (*Wild red cherry*), *Prunus serotina* (Ehrh) (*Wild Black Cherry*), *Cercis canadensis* L. (*Redbud*), *Sassafras sassafras* (L.) Karst. (*Sassafras*), *Crataegus* (various species), *Acer saccharum* Marsh (*Sugar or Rock Maple*), *Juglans cinerea* (L) Britton (*Butternut*), and *Juglans nigra* L. (*Black Walnut*).

The infrequent *Acer* and *Juglans* are prophecies of the future mesophytic forest, which, in a state of nature, was gradually developing.

In the drainage valleys and on the median plane, the above species of oaks and hickories are less abundant, and a number of other species, which are characteristic of the strictly mesophytic forest are fairly common; as, *Ulmus Americana* L. (*American elm*); *Acer saccharinum*, L. (*Soft Maple*); *Fagus Americana* (*Sweet Beech*); *Tilia Americana*, L. (*Basswood*); *Quercus macrocarpa* Mx. (*Burr-oak*); *Ulmus fulva*, Thomas (*Slippery Elm*); *Quercus plantanoides* (Lam) Sudw. (*Swamp White oak*); *Quercus palustris* Du Roi (*Pin oak*); *Hicoria minima* (Marsh) Britt. (*Bitternut*); *Fraxinus Americana* L. (*White Ash*); *Fraxinus quadrangulata* Michx. (*Blue Ash*); and *Fraxinus lan- ceolata*, Borck. (*Green Ash*).

On a slight elevation just east of the Johnson Celery Farm, there occurs a clump of trees consisting of

eleven White Oaks, four Red or Black Oaks, two Shingle Oaks, three Hickories, and a large Elm, the last was situated in a slight depression, and is over two feet in diameter.

The principle shrubs of the xero-mesophytic area are *Corylus Americana*, Walt. (Wild Hazel-nut); *Rhus aromatica*, Ait (Fragrant Sumac); *Crataegus*, (several species); and *Rhus glabra* L. (Upland or scarlet sumac); while the following are quite common: *Hamamelis virginiana* L. (Witch hazel); *Rhus radicans* L. (Poison Ivy); *Viburnum prunifolium* L. (Black haw); *Viburnum pubescens* (Ait) Pursh. (Downy leaved arrow-wood); *Rubus villosus* ait. (High-bush blackberry); *Rubus occidentalis* L. (Black raspberry); *Ribes Cynobasti* L. (Wild Goose berry); *Rubus Canadensis* L. (Dew-berry); *Vitis* sp? *Ptelea trifoliata* L. (Shrubby tree-foil); *Viburnum acerifolium* L. (Maple-leaved arrow-wood); *Celastrus scandens*, L. (Climbing Bittersweet); *Smilax*, several species; *Parthenocissus quinquefolia* (L.) Planch (Virginia Creeper); and *Enonymus atropurpurens*, Jacq. (Wahoo, or burning bush). Three of the above species *Rhus aromatica*, *Ptelea trifoliata*, and *Crataegus* were found growing, in the Summer of 1902, on a sand dune along the shore of Lake Michigan, thus proving the xerophytic capabilities of these species. Frequently by the lagging behind of effects, xerophytic plants will cling to an area for a considerable time even after the conditions have changed to the xero-mesophytic or to the mesophytic.

On the median plane and the drainage valleys, most of the above species also occur, but not so commonly; while *Benzoin benzoin* (L.) Coult. (Spicebush), *Cornus*, several species; *Rosa* sp?; and *Xanthoxylum Americanum* Mill. (Prickly Ash) are quite abundant.

The common or characteristic herbaceous plants of the xero-mesophytic area are *Antennaria plantaginifolia* (L.) Rich. (Plantain-leaf Everlasting), which fre-

quently carpets large areas; *Euphorbia corallata*, L. (Flowering spurge); *Syndesmon thalictroides* (L.) Hoffinsg. (Rue Anemone); *Lithospermum canescens*, (Mx.) Lehm. (Hoary Puccoon); *Desmodium*, several species; *Hedeoma pulegioides* (L.) Pers. (American pennyroyal); *Heliopsis scabra*; (L.) B. S. P. (Rough Ox-eye); *Aster laevis* L. (Smooth Aster); *Aster undulatus* L. (Wavy-leaf Aster); *Aster ericoides* L. (White-heath Aster); *Solidago*, several species. In the mesophytic woodlands occur the usual early geophilous Spring flowers in abundance, while in the Autumn the following flourish: *Eupatorium ageratoides* L. (White snake-root); *Adicea pumila* L. (Raf. Richweed or clearweed); *Impatiens biflora*, Walt. (Spotted touch-me-not); *Lobelia syphilitica* L. (Blue lobelia); *Aster Novae-Angliae* L. (New England Aster); *Sanicula Marylandica* L. (Black snake root); *Urticastrum divaricatum* (L.) Kuntze (Wood Nettle), etc. One specimen of *Aralia racemosa* L. (American Spikenard) was found in one of the wettest woods, which occurs on the median plane.

All gradations between the xero-mesophytic and the mesophytic societies occur on different portions of the Ridges according to the direction and steepness of the slope, and the depth and character of soil.

ROADSIDE SOCIETY.

Along the roadsides and fence-rows, especially old worm-fences, some of the plants, originally occurring on the area, survive and flourish, silent witnesses of the character of former conditions and plant societies. More frequently they offer ready footing to new arrivals, prophecies of future societies. As a rule the conditions of life of roadside plants are much more adverse than those of fence-rows, and in consequence they must possess greater power of surviving in spite of hard

usage. On account of the more abundant opportunities for artificial or accidental seed dissemination along highways, these latter societies possess a greater variety of plant life than fence-rows away from highways. The most successful roadside plants are those, which, when broken or cut off, have the power of sprouting up from the stub or root. These sprouts are generally quite prolific in seed production. It is also of advantage for these plants to possess a perennial underground rootstock as many of them do. The inequalities in the level of a cross-section of the average country pike or road furnish conditions for extremely varied sub-divisions in Roadside societies.

The traveled roadbed is extremely xerophytic, the ditch or depression commonly occurring may support a hydrophytic society, while the remainder of cross-section may offer narrow beds of xero-mesophytic, and mesophytic, and hydro-mesophytic. Thus all forms of plant societies may exist in duplicate on each side of a road not over fifty to sixty feet in width. On account of the frequent rock outcrops, the roadways of the Ridges are more evenly xerophytic or xero-mesophytic than is commonly the rule; but in the drainage valleys and on the median plane the ordinary type roadway with its varied plant societies occur. The most characteristic roadside shrubs of the Ridges are *Rhus aromatica*, *Rhus toxicodendron*, and *Celastrus scandens*. Other quite common species are *Rhus glabra*, *Rubus occidentalis*, *Rubus villosus*, *Rubus Canadensis*, *Crataegus*, *Prunus*, *Smilax*, and *Vitis*.

The most characteristic herbaceous plants are *Aster multiflorus* Ait. (Dense-flowered Aster); *Asclepias tuberosa* L. (Butterfly-weed, Pleurisy root); and *Pentstemon hirsutus* (L.) Willd. (Hairy Beard-tongue).

In this locality, the writer has found *Aster multiflorus* growing only on the Ridges, while at Chicago, Ill., it occurs on level sandy commons or even along

side-walks in the vicinity of the University of Chicago. As another instance of this difference of habit, may be mentioned *Celtis occidentalis* which, in Wyandot County, Ohio, occurs chiefly on ridges or bluffs, while in Illinois it is found only on the flood-plains of streams, as on the flood-plain of the Des Plaines at Riverside. A slight decrease in atmospheric humidity between two places is often sufficient to limit to very narrow boundaries the habitat of certain species; which in the more favorable localities have a wider range.

Other common herbaceous plants of the Ridge roadsides are *Melilotus alba* Desv. (White Melilot); *Plantago lanceolata* L. (Ribgrass); *Poa compressa* L. (Wire-grass); *Euphorbia* (several species); *Lithospermum arvense* L. (Corn Gromwell, Wheat-thief); *Triosteum perfoliatum* L. (Horse-Gentian); *Solidago* (various species); *Aster* (various species); *Achillea millefolium* L. (Yarrow); *Bidens* and *Carduus* (several species).

Polygala senega L. (Seneca Snakeroot) is rarely found on the ridges, and is one of the witnesses of former plant societies.

The most characteristic weed of wheat-fields is *Lithospermum arvense* (Corn Gromwell. Wheat thief), while *Ambrosia* (Ragweed), *Amarantus* (Pigweed) and *Chenopodium* (Lambs-quarters) are also quite common.

The region adjoining the prairie on the north and west was covered with a typical mesophytic forest formation of the Maple, Basswood, Beech type, with its characteristic shrubs and herbs.

2. PAST CONDITION OF THE PRAIRIE-HISTORICAL FACTOR.

On Sept. 17, 1818, a treaty was agreed upon between the U. S. Government and the Wyandot Indians. One of the articles of this treaty reads as follows: "That there shall be reserved for the use of

the Wyandots residing near Solomon's Town and on Blanchard's Fork in addition to the reservation before made, sixteen thousand acres of land to be laid off in a square form on the head of Blanchard's Fork, the center of which shall be the Big Spring on the trace leading from Upper Sandusky to Fort Findlay." This reservation is indicated by a dotted boundary line on Map I. This section was granted to the Indians because such a large portion of it was unfit for agricultural purposes; while, at the same time, it formed an excellent hunting ground for them on account of the abundance of game of various kinds. Even after the reservation was thrown open to settlement deer, beaver, otter, mink and various species of water fowl were quite common. From the wording of the article granting the Big Spring Indian Reservation to the Wyandots, one would be justified in inferring that the Big Spring was at the head of Blanchard's Fork in 1818. If this is true, there must have been a natural drainage for this section in the earlier years of the past century, and as there was no well-defined outlet when the reservation was thrown open to settlement, the outlet or Blanchard's Fork must have become so clogged up that nearly all traces of the original stream became obliterated. In a history of Seneca County the following occurs: "Big Spring was once a very powerful one, and formed a small lake. Clearing of land decreased its importance." The reservation was ceded to the U. S. in 1832 Jan. 19th, and was thrown open to settlement in 1833. Big Spring township, Seneca County, was formed March 6, 1833. The town of Springville was laid out in 1834, by which time, most of the ridge land was occupied by settlers. During this year there occurred in this section, a very destructive late Spring frost.

In 1837 the crops were greatly injured by drought. Even the marsh was well dried off for that day. The

Hocking Valley R. R. was built across a portion of prairie in 1877-78. After this, the serious prairie fires, burning even the soil, became prevalent.

The first dwelling house was built on the actual prairie in the summer of 1901. At present there are several dwelling houses upon this area.

In an interview, Mr. Peter Brayton, a pioneer of Springville, whose recollections date back to 1833, when Big Spring Indian Reservation was thrown open to settlement, stated that, in his boyhood, the prairie, which was then known as the Big Prairie in distinction from a small prairie of several hundred acres about one and a half miles east, was covered with water for the greater portion of the year. In Winter and Spring there was a continuous sheet of water from Carey to Vanlue, a distance of about ten miles. This sheet varied considerably in width and depth. Except in wet years, most of the marsh would dry off considerably in late Summer and Autumn.

A short distance north of the new road just south of Springville, there was still a permanent lake, which contained from two to four feet of water even in dry seasons. It was known as The Lake, although it was only about two miles long and twenty to fifty feet wide. Beyond this space of clear water, there was a shallower portion in which cattails, reeds, and bulrushes grew. The body of water was the last remnant of a rapidly dying lake.

The common testimony of several pioneers of this region is, that during wet Springs, canoe trips could be taken from near the cemetery just north of Carey to Springville, and that during the winter the boys would skate over this same route.

Judging from present conditions of level, the above statements scarcely seem possible, as the Divide at present occurs along new road No. 1 Map I; and this divide, according to the surveyor's measurement is about eight

feet higher than the level of prairie just north of Carey, and about ten to twelve feet higher than the lower end of old lake. Consequently, if the water was deep enough for canoeing upon the divide, and if the general level and slope were then as now, the depth of water just north of Carey must have been about eight feet and at the lower end of old lake about ten feet. But this is impossible, as it would have flooded the present site of Carey, and would have been drained into Spring Run.

Either the statements are false; or the divide has been built up considerably within the last seventy years and the general level of prairie just north of Carey and of lower end of lake are considerably lower than formerly. These last two phases will be further discussed under Drainage of Prairie, past and present and its effect upon general level of same.

It was impossible to get any reliable scientific data in regard to flora of prairie in the earlier part of the nineteenth century; but, according to statements of the pioneers, cattails, reeds, bulrushes, poison sumach (popularly called "poison shumake"), boneset, wild sun-flowers, and sedges were more abundant; while willows occurred only along the border of prairie or marsh and on a few isolated spots which were slightly higher than the general level. The wild rose occurred less frequently than at present; and the elderberry, which became so common in late years did not occur at all upon the prairie until artificial drainage was put into operation. Before this, it was one of the common plants on certain portions of the ridges.

Large areas of sedges, known as marsh grass by the old settlers, were mown for the hay. As no areas of any size were available for this purpose in late years, the almost pure sedge societies have been supplanted by other more-varied plant societies.

Although the Big Spring Prairie was in reality a marsh, perhaps similar to the Skokie Marsh in northern

Illinois, the sod, consisting of tangled sedges and grasses of the preceding year, and of the growing sedges and grasses, offered such a firm support that the marsh could be safely crossed by horses without the danger of miring, but at each step of the horses feet the ground would quiver for many rods in either direction. After the sedges and grasses were mown for hay by the settlers they would set fire to the dried sedges and grasses in the Autumn, in order that the areas might be more suitable for mowing the next year. This led to a curious but natural result. Whereas before these prairie fires cattle and horses could graze over this area without miring; after a repetition of these Autumn fires, the burned areas became so soft and treacherous, that cattle and horses frequently mired in them.

Naturally the burning of the dead sedges and grasses prevented the formation of the dense carpet of tangled vegetable remains, and thus the upper crust being broken in places, the area became a true morass. This condition continued until ditches were dug and the land, for the time being, became fairly well drained. Besides the sedges and grasses the most common plants were

- Typha latifolia*—(Cattails);
- Phragmites phragmites*—(Reeds);
- Eupatorium perfoliatum*—(Boneset);
- Aster* (several species)—(Wild asters);
- Potentilla fruticosa*—(Shrubby Cinquefoil);
- Betula pumila*—(Low Birch);
- Rhus vernix*—(Poison Sumac, or Poison Elder.);
- Helianthus* (several species)—(Wild Sunflowers);
- Solidago* { *Riddellii*
and
Ohioensis } Probably—(Goldenrods)

Some less common plants were

- Lacinaria spicata*—(Blazing Star, or Gay Feather);
- Parnassia Caroliniana*—(Grass of Parnassus);

Lobelia Kalmii—(Kalm's Lobelia, or Brook Lobelia);

Lobelia syphyllitica—(Blue Lobelia, or Great Lobelia);

Lobelia cardinalis—(Cardinal flower);

The following plants were more rarely found upon it than in later years

Rosa carolina—(Swamp rose);

Salix (various species)—(Willows);

Urtica gracilis—(Slender Nettle).

Ordinary weeds from cultivated ground were not found growing upon it.

Trees were much less common on prairie in 1833 than in later years. They occurred only on the old clay islands, the sand dunes, and along the margin of the prairie where muck was quite thin. On the portions covered with sedges and grasses, no seedling trees made their appearance.

The first trees to make their appearance were the Willows, Poplars, Elms, and Soft Maples. On the sand-dunes oaks had already made their appearance in 1833.

DRAINAGE OF THE PRAIRIE—PAST AND PRESENT.

From the configuration of the territory embraced in area represented in accompanying map, and from the arrangement and depth of the drift material in the various portions, one would be justified in inferring that the preglacial drainage of this section differed materially from the one in post-glacial times.

The portion of Big Spring Prairie between Carey and Springville, and included between North Ridge and West Ridge, presents a striking resemblance to an old river valley, which might repay investigation by the geologists of the state, who have made extensive investigations along this line in other portions of the state. If this surmise in regard to old river bed is correct, as the evidences seem to indicate, the drift mater-

ials of the glacial epoch were deposited in such a manner that a lake was formed on the present site of the prairie, a greater deposition of drift occurring at the south end of the valley, and also to the north and west of the prairie area.

This lake differed but slightly in outline from the present prairie, and it differed considerably in depth. From borings on this area the greatest depth did not much exceed thirty feet and considerable portions were only a few feet in depth, for in some localities the difference in depth between the surface level and the drift clay or solid rock is quite slight. Bowlders resting on shallow drift clay occur in angle formed by the road-beds of the Hocking Valley R. R. and the Northern Ohio R. R. and just east of this point, in fact just across the tracks, the Niagara limestone lies scarcely two feet below the surface. Bowlders also occur on a rather large area in the vicinity of Springville. Further investigation would be needed to determine whether the preglacial stream flowed northward or southward between the North and West Ridges.

That this area was a lake in post-glacial times is evidenced by the fact that quicksands, old lake beaches, sand-dunes, etc., exist in various portions. These will be more fully discussed under the various natural areas and plant societies into which the prairie can be divided. When this region was first settled, the natural drainage of the southern portion of the east arm was a broad gradual slope to Spring Run, joining it at the present site of the Gault House, Carey, Ohio. No definite stream existed in this portion within the memory of man; but that such an outlet formerly existed is evidenced by the fact, that the nearly obliterated remains of a beaver dam occurs in the southern portion of this area. It extended in an easterly and westerly direction about half way between Dow street and the Northern Ohio R. R. It filled the gap between the

slope of West Ridge and the locality just across the Hocking Valley R. R., where the Niagara limestone lies within a foot or two of the surface.

The northern portion of the prairie from Springville westward was drained by the outlet mentioned in the treaty, which was made with the Wyandot Indians in 1818. The Blanchard River is about five or six miles west from the western boundary of the Indian Reservation. In the treaty this would scarcely be referred to as the head-waters of Blanchard's Fork, so there must have been a tributary of this name sufficiently open to warrant mention. According to the testimony of the older settlers, there was no well-defined open stream in 1840. Blanchard's Fork must have gradually become clogged up by an encroaching growth of cattails, sedges, grasses, water-plants, and arrow-leaves: thus producing the sluggish outlet frequently mentioned by the old settlers.

The southwestern extremity of prairie near Vanlue had a broad sluggish drainage to the southwest along two shallow valleys.

Whether all of these outlets existed when the area was a lake, or originated after it had developed to the marsh type, it is difficult to determine: but, most probably the outlet was the only one, the others originating after the surface of marsh was built up higher than the original level of the lake.

This would seem to be a natural consequence, for there are several areas of limited extent in various portions of the prairie which would corroborate this view. These areas are elevated several feet above the surrounding level, although they consist of muck, of as great or greater depth than the adjoining portions. This greater elevation of a portion of a marsh is a common formation in a Sphagnum swamp. The writer has never been able to find any Sphagnum whatever on this area, or any traces of it in the muck, although

Dr. W. A. Kellerman and myself have made microscopic examinations of muck obtained in localities where it would have been most likely to occur. It either existed formerly, even if no traces have been found, or other forms of plant life possess the same power. As before mentioned a remnant of the old lake existed as late as 1850, occupying a portion of the bed of the old outlet, or Blanchard's Fork.

By an inspection of the Map, it will be seen that the drainage at present is in the same three general directions as mentioned under natural drainage while the area was a marsh. The Divide occurs along New Road No. 1. The territory to the south of this road is drained into Spring Run, the water eventually finding its way into Sandusky Bay by way of Tymochte Creek and Sandusky River.

The ditch, draining into Spring Run, does not follow the natural drainage course to vicinity of Gault House, but veers eastward just north of Carey and empties into the Run near the Hocking Valley Depot. The territory north of the Divide is drained northward, then westward and empties into the Bower Ditch just west of the Seneca-Hancock County line. The waters of this ditch reach Lake Erie via the Blanchard, Auglaize, and Maumee Rivers. The Vanlue end of prairie is drained by several ditches whose waters empty into the Blanchard River.

ARTIFICIAL DRAINAGE AND ITS EFFECTS.

The first drainage ditch was dug about 1860. This drained the old lake remnant, and led to the gradual decrease in strictly hydrophytic plants. The second ditch drained into the old lake bed. It extended from the western edge of prairie, eastward along Seneca-Wyandot County line, and then northward along the eastern margin of prairie, then northwestward, empty-

ing into the old lake bed. The third ditch extended from the vicinity of New Road No. 1 chiefly along the western portion of prairie, then along southern border, and emptied into Spring Run as at present. A number of lateral ditches draining into these were dug. As a result of this drainage, portions of the prairie became fit for cultivation, other portions formed excellent pasture lands.



FIG. 1.—BOWLDER SHOWING SETTLING OF SOIL

Although the drainage ditches were occasionally cleaned out and deepened, in the course of years, the area began to revert to the marsh type. The flow of the water became more and more sluggish. It was found necessary to abandon some of the cultivated portion as it could no longer be properly drained. An unlooked for result had occurred. The general level of the drained portion of the prairie was lowered to such

an extent, that the mesophytic condition was gradually reverting to the hydrophytic condition again.

As evidence of the settling of the soil and the extent of the settling, we would call your attention to figure 1 which shows a large boulder resting on drift clay. The location of this boulder is indicated on the Map. The dark band along the side of rock near the top marks the old marsh level; the shorter band of dark and light streak near the base of rock was exposed by prairie fire which burned the soil several years ago. The picture does not do justice to the real appearance of the rock. The portion above the upper band is old and exceedingly weatherworn, and partially covered with mosses. The portion below the upper band has a clean, bright surface as if it had been more or less acted upon by humic acids. The difference in the appearance of these distinct areas is far more striking on the boulder than in the picture. The decrease in level of this part of prairie is thus shown to be about $2\frac{1}{2}$ feet.

Mr. Peter Brayton states that when a young man, he was one day walking across prairie not far from the edge, a short distance north of New Road 2, which crosses his farm. The ground was wet and springy. At each step, his feet would sink into the muck. He happened to step upon something solid. Upon investigation, he found it to be a boulder, whose top was slightly below the surface. In 1899, the boulder was projecting about 20 inches above the surrounding level. This seeming elevation of boulder, and actual settling of soil occurred after artificial drainage was introduced.

The old settlers are quite unanimous in their testimony, that a person could shake many square rods of ground by jumping upon one of the "bogs" as they called the "sedgy hummocks" projecting above the general level; and also, that portions of prairie muck seemed to be quite deep as poles could be thrust vertically into the soil to the depth of ten feet or more. At

present, they are at a loss how to account for the fact, as the muck in those identical places is now only three or four feet deep. Below the muck, there is either a sand bed, a layer of clay or both. The testimony of the bowlders clears the mystery, for the muck was formerly deeper, and the sand-layer beneath was a quicksand, such as is yet encountered while making



FIG. 2.—TREE WITH EXPOSED ROOTS, SHOWING SETTLING SOIL.

excavations for the abutments of some of the bridges across the prairie streams. When thoroughly drained, the quicksand becomes a solid bed. The settlers, ignorant or unmindful of the quicksand beneath, were mistaken in supposing that the entire depth penetrated was muck.

As further evidence of the amount of settling of the soil, we would direct your attention to figure 2.

This tree is situated in a low woods, adjoining the prairie and at the junction of a shallow drainage valley from West Ridge. It is about two rods distant from the ditch draining southern part of prairie. The tree is 59 inches in circumference just above the exposed roots. The amount of settling indicated is about $2\frac{1}{2}$ feet. Figure 3 shows another tree 36 inches in circumference. It is situated in same woods, but a short distance up the slope of this natural drainage valley. The amount of settling at this point is about 24 inches. Considerable of this settling was due to the last deepening of the outlet of this prairie ditch in 1897.

Several wooded areas of this prairie, whose principal genera are *Ulmus*, *Fraxinus*, and *Acer* exhibit a like tendency to prominent or exposed roots. Whenever the roots of trees are imbedded in a solid clay subsoil, and the soil settles, it will leave the upper roots exposed as illustrated in figures 2 and 3. Thus, in part, we can read the history of the past of such areas by the present conditions.

Since the settling of the soil tends to cause a reversion of the plant societies, it is of considerable interest to further investigate the subject of drainage and its effects; especially as prairie fires which burn the soil as well as the vegetation upon it are, upon this prairie, a direct result of artificial drainage. Before artificial drainage was introduced, the burning of the soil did not occur, as the muck was surcharged with water. The enclosing ridges and the solid rock bed underlying the prairie renders this a peculiar kind of prairie. The edge of the prairie is lined by a number of springs, the natural outlets of the subterranean drainage of the ridges; the rock strata of these ridges, as before explained, dipping toward the low ground and hence in this region toward the prairie, the subterranean water must rise in prairie muck until it rises sufficiently high to be drained off by the prairie ditches. For this reason,



FIG. 3.—TREE SHOWING SETTLING OF SOIL BY ITS EXPOSED ROOTS.

most of the earlier ditches were dug chiefly along the edges of prairie, thus intercepting the waters from the springs. The destruction of the forests on the ridges, and the construction of tile ditches and open ditches have considerably lessened the importance and magnitude of the springs along the margin of prairie, thus aiding in the evolution of plant societies. After the soil became drier, and especially after the construction of the Hocking Valley R. R. across this area, prairie fires became prevalent.

In order to investigate the amount and causes of the settling of the soil, direct experiments with soils were performed. Samples of soil were collected, weighed, and measured while still wet. After thoroughly drying in a slow oven, the soil was again weighed and measured. The dry soil was then burned, and the weight and volume of ash determined, in order to learn what amount of settling of soil was due to prairie fires and what amount to drainage. These prairie fires have rapidly changed a mesophytic area to a hydrophytic one, extensive depressions occurring on the areas burned over, and as the drainage of the ditches became more sluggish, these depressions would fill with water, which would scarcely dry up even in dry seasons. A number of such areas came under the writer's observation between 1891 to 1897. In the latter year the outlet was deepened by blasting the rock in bottom of ditch from the point where the outlet empties into Spring Run to the bridge just north of the Northern Ohio railroad station. The point where deepening ended is shown in figure 4, the rude fence marking the limit.

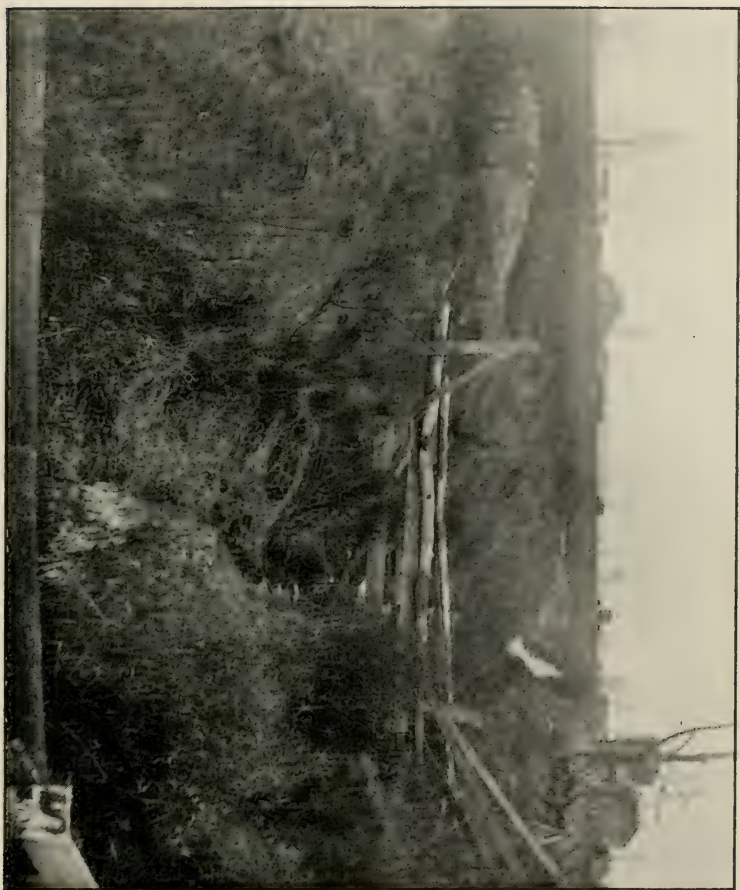


FIG. 4.—SHOWING THE BROWN DITCH AT WESTERN LIMIT OF DEEPENING.

EXPERIMENTS WITH SOIL.

Soil No. 1, taken from the bottom of a ditch 6 feet deep near the Johnson celery farm, gave the following results:

Wet soil, after draining 48 hours.....	160	oz
Dry soil, (dried in slow oven).....	20	oz
Loss in weight.....	140	oz
Loss %.....	87½	%
Volume of wet soil.....	4	qt
Volume of dry soil.....	1¾	qt
Loss in volume.....	2½	qt
Loss %.....	56½	%
Volume of dry soil..... 1 qt. 1 pt.	2	gi.
Volume of ashes.....	3	gi.
Loss in volume 1 qt. 0 pt.	3	gi.
Loss %.....	78⅙	%

Soil No. 2, taken from about 10 inches below surface on celery farm.

Weight of soil, undried.....	112	oz.
Weight of soil, dried.....	26	oz.
Loss in weight.....	86	oz
Loss %.....	76¾	%
Volume of soil, undried.....	3	qt.
Volume of soil, dried.....	1½	qt.
Loss in volume.....	1½	qt.
Loss %.....	50	%
Volume of dried soil.....	12	gi.
Volume of ashes.....	3½	gi.
Loss in volume.....	8½	gi.
Loss %.....	70⅝	%

Soil No. 3. Clay subsoil, taken from wooded area near south end of prairie.

Weight of clay undried.....	14	lb.
Weight of clay dried.....	11	lb.
Loss in weight.....	3	lb.
Loss %.....	21⅓	%
Loss in volume slight.		

Soil No. 4. Clay mixed with sand, taken from edge of ditch at south end of prairie.

Weight undried.....	20 lb.
Weight dried.....	16 lb.
Loss in weight.....	4 lb.
Loss %.....	20 %
Loss in volume slight.	

Soil No. 5. Taken from field E. of Map II.

Weight of wet soil, drained 24 hours.....	72 oz.
Weight of dry soil.....	32 oz.
Loss in weight.....	40 oz.
Loss %.....	55 %
Volume of wet soil.....	4 pt.
Volume of dry soil.....	2½ pt.
Loss in volume.....	1½ pt.
Loss %.....	37½ %
Volume of dry soil.....	2½ pt.
Volume of ash after burning.....	1½ pt.
Loss in volume.....	1½ pt.
Loss %.....	50 %

	Loss per cent. in weight in drying.	Loss per cent. in volume in drying.	Loss per cent. in volume in burning.
Soil No. 1, Muck from depth of 6 ft.....	87½	56½	78⅔
Soil No. 2, Muck from depth of 10 inches...	76¾	50	70⅝
Soil No. 3, Clay subsoil.....	21¾	slight	
Soil No. 4, Clay mixed with sand.....	20	slight	
Soil No. 5, Muck from cultivated surface...	55	37½	50

From the above data, we see that the surface soil has lost $37\frac{1}{2}$ per cent. in volume, the soil at a depth of 10 to 12 in. 50 per cent., while the soil from a depth of 6 feet lost $56\frac{1}{4}$ per cent.

Under natural conditions, the soil will not dry as thoroughly, and in consequence will not lose as great a per cent. in drying, perhaps considerably less than half; but the ratio of loss will remain approximately the same. The soil from near the surface lost less in volume because it contained a smaller amount of water, and because the vegetable matter of which it is chiefly composed had already undergone some oxidation.

Chemistry teaches us that a slow oxidation will practically accomplish in the course of years what a rapid combustion will accomplish in a few hours.

The burning of the deeper soil gave a loss of $78\frac{6}{7}$ per cent., of the soil from near the surface $70\frac{5}{6}$ per cent. making a difference of 8 per cent. Thus a partial oxidation of soil had taken place in the latter and a consequent decrease in volume resulted. As this area had been drained but a few years, we can gain some idea of the importance of this phase of the subject. A complete oxidation of the vegetable portion of the soil will cause approximately the same decrease in general level as the burning of the soil, which has been occurring of late.

There are four causes at work in reducing the general level of this area:

1st. Withdrawal of the water from the soil and the consequent shrinkage in volume as determined by direct experiment.

2d. Drainage produces aeration of soil; and the resulting oxidation of its vegetable remains, by which great portions pass off as gases, cause the remains to settle more closely together.

3d. Burning of the soil, which produces most rapid and greatest difference in level.

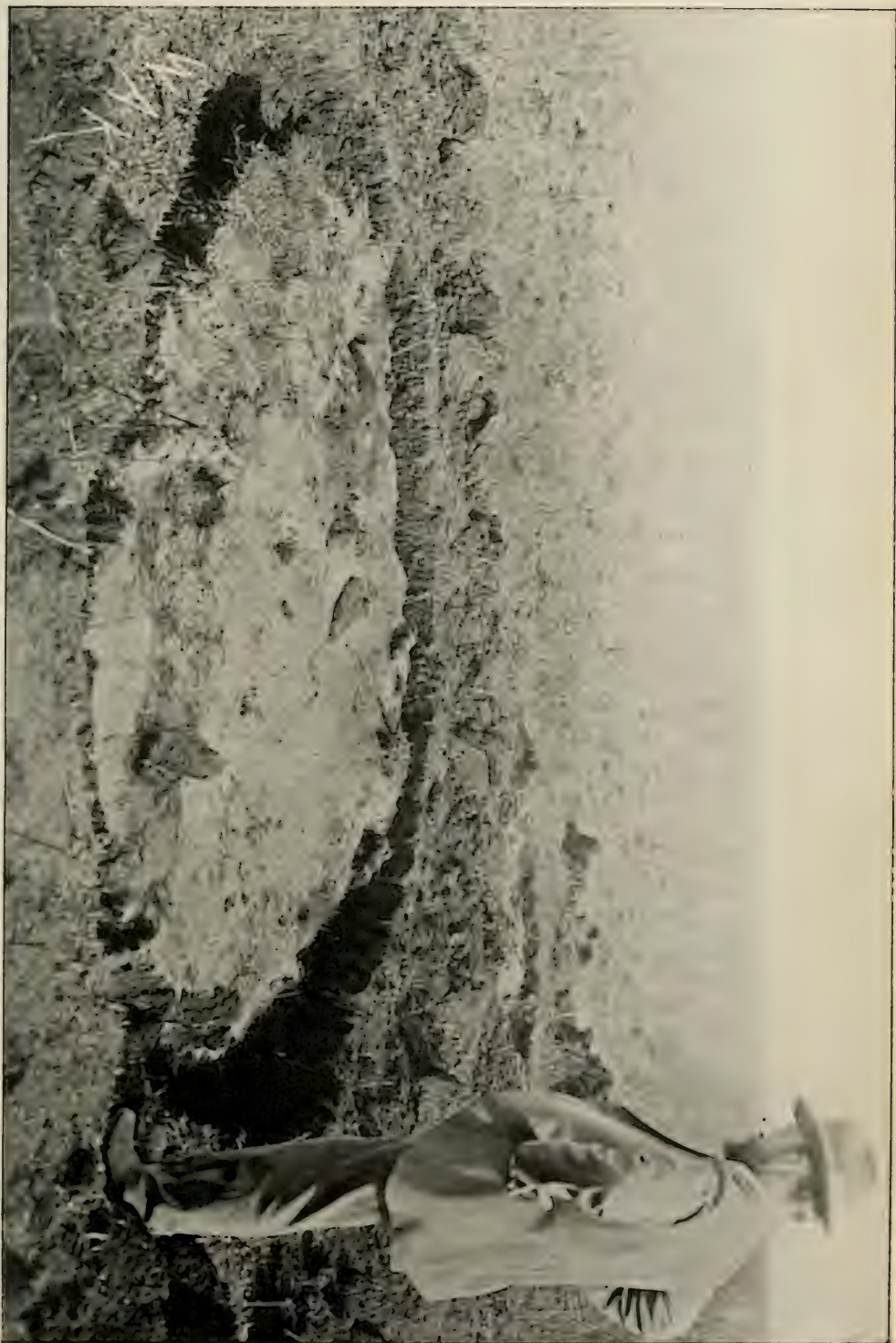


FIGURE 1. SHOWING BURNING OF SOIL, AND MEANS EMPLOYED TO PREVENT ITS SPREADING.

4th. The erosion of surface soil in the vicinity of ditches.

The above four causes are direct results of artificial drainage.

This settling of marsh soil after drainage becomes of economic importance. For, if there is just enough difference in level to secure proper drainage when the first ditches are dug, the area in the course of years, is bound to revert to the semi-marsh type, if the muck is sufficiently thick.

If, however, the fall in outlet ditch is sufficiently great, the ditches must be deepened from time to time, until the first two causes have approximately accomplished their work. The third force or cause does not manifest itself on all drained marsh areas. But wherever it is liable to occur, provision must be made both for prevention, if possible; and for staying its destructive progress.

Figure 5 illustrates a method employed on Big Spring Prairie to stay the ravages of prairie fires. The dry prairie grass was set on fire by sparks from a passing engine. The sedgy or grassy hummocks projecting above the general level are quite dry, and hence are set on fire by the burning grass. The heat from this burning portion expels the moisture from the soil in immediate contact with it and raises it above the igniting point and the fire spreads. Before the real value of this marsh land was learned, little effort was made to check its progress unless it threatened to encroach upon fences or the land adjoining prairie. But, after Mr. W. C. Johnson proved the value of this marsh land by developing a celery and truck farm upon it, the land rose in value from \$10 an acre to \$75 or even more.

At present if a prairie fire originates, which threatens the burning of the soil, a trench is dug around the burning area. If the trench is deep enough to reach very wet soil, it effectually prevents its further ravages

as shown in the illustration. This settling of drained marsh land is not peculiar to Big Spring Prairie, but was noticed by the tillers of the Scioto Marsh. This marsh was formerly wooded. After it was drained, the land was cleared and cultivated. After ten to fifteen years of cultivation, the stumps seemed to be growing in height, and logs imbedded under the surface were exposed. The amount of settling varied from one to two feet. The farmers of that section ascribed the apparent elevation of the stumps to the settling of soil consequent upon cultivation.

The first and second causes above enumerated are sufficient to account for the amount of settling of the soil. Mr. W. C. Johnson, former proprietor of the Wild Rose Celery Farm, stated that the Creston, O., marsh had settled at least ten feet, and that Mr. John Brinkerhoff, the surveyor, who has frequently surveyed and leveled the marsh for securing data of water level for ditching, has observations to this effect on record. Formerly this marsh possessed a slow natural drainage, now a ditch about ten feet deep scarcely drains it.

Under this subject, it may be of interest to give graphic representations of the advance or retrogression of plant societies under varying conditions.

We shall employ Warming's three classes of Xerophytes, or drought-enduring plants; Hydrophytes, or water-loving plants; and Mesophytes, or plants thriving best in medium condition of moisture. The class Halophytes may be ignored in this connection.

The process of the filling up of a shallow lake margin is quite rapid from the time the first bulrush makes its appearance above the water, until the area so covered has been transformed into a marsh, which is covered with water for only portions of the year. From that stage to the strictly mesophytic prairie the advance becomes gradually slower and slower, as portions of the vegetable remains by the alternate soaking and dry-

ing pass off as gases, and thus a correspondingly less amount of humus is accumulated.

The rapidity of the above mentioned process was strikingly exhibited by a pond on the Lawrence Straw farm in the Sandusky River Valley. This pond came under the writers observation in 1893. At that time there was still a small area of clear water in the center for the greater portion of the year. The remainder of pond was covered with quite shallow water, in which there flourished a rank vegetation of cattails, calamus, and various sedges. At present there is no longer any clear area of water, at any time of the year; and the greater portion of the original pond is now above the permanent water level for by far the greater portion of the year. This advance has been made in ten years. As this dead pond is enclosed on two sides by high hills, and as several deep gullies discharge their waters into this area, the erosive material carried into it was an important factor in its rapid advance. But the like factor existed formerly in regard to Big Spring Prairie, as West Ridge fills in the inner curve of the bow, and North Ridge extends along its eastern border. The present broad, shallow drainage valleys were formerly narrow and deep gullies carrying into the old lake a large amount of silt consisting of sand and clay, which were deposited in different places in varying proportions.

The following figure will illustrate the foregoing graphically under the condition of natural drainage:

XEROPHYTIC

MESOPHYTIC

HYDROPHYTIC

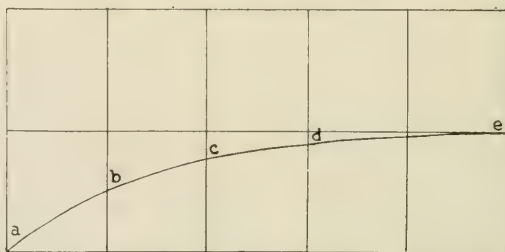


FIGURE 6. DIAGRAM OF CURVE OF ADVANCE UNDER NATURAL DRAINAGE.

Horizontal lines indicate time. Vertical lines indicate rapidity of filling up or change.

a—First bulrush or cattail making its appearance.

b to c—Curve of advance from shallow lake to marsh.

c to d—Curve of advance from marsh to semi-marsh.

d to e—Curve of advance from semi-marsh to mesophytic prairie.

Under artificial drainage this curve must be modified to meet the new conditions, and hence the following diagram will illustrate it:

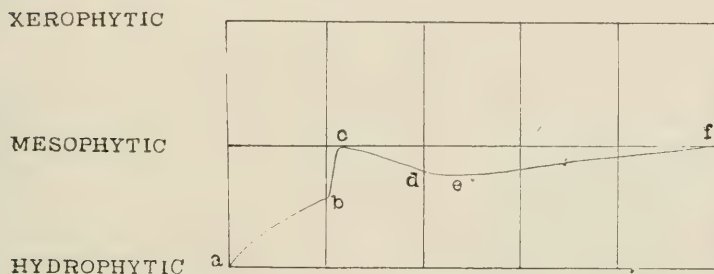


FIGURE 7. DIAGRAM OF ADVANCE AND RETROGRESSION UNDER ARTIFICIAL DRAINAGE.

a—Appearance of first bulrush or cattail.

a to b—Advance under natural drainage.

b to c—Effect of artificial drainage.

c to d—Settling of soil and erosion.

But the condition of greatest water content of soil will not be reached until the outlet ditch becomes completely clogged up with plant remains whose accumulation will be greater here than where there is less moisture. Consequently a barrier retarding drainage will be built up and the conditions on the originally drained portion will for a time become more hydrophytic as indicated by the curve "*d to e*." When "*e*" greatest degree of marshiness has been attained, the natural process of advance will again tend to carry the

area to the mesophytic condition. The above represents the curve if only one effort at drainage has been made. If the ditches are cleaned out or deepened, new curves must be accordingly introduced at the proper stage.

If the soil takes fire after drainage, and a severe burn ensues, the curve will need adjustment as follows:

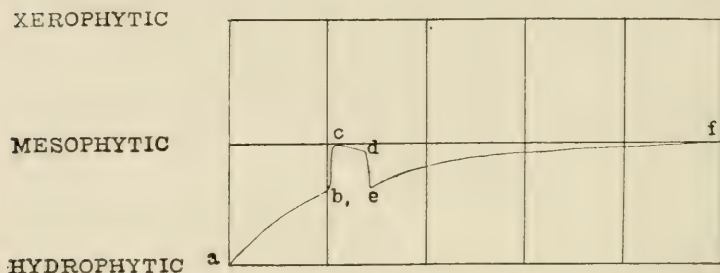


FIGURE 8. RETROGRESSION AS RESULT OF THE BURNING OF SOIL.

a to b—Advance under natural conditions.

b to c—Advance under artificial drainage.

c to d—Stage of settling before prairie fire.

d to e—Retrogression as result of prairie fire.

e to f—Advance under natural conditions.

As before stated, the first ditches were dug about 1860, but by 1890 certain portions of prairie had so far reverted toward former conditions that a joint county ditch was petitioned for and granted by the proper authorities of Seneca and Hancock counties. This ditch was constructed in 1891 and is known as the Bower Ditch as represented on Map I.

Figure 9 gives an illustration of it some distance beyond the prairie area. The greater portion of this outlet is cut through a considerable thickness of clay now quite firm. The muck above it has undergone considerable oxidation and consequent settling. This outlet will furnish adequate drainage for great portions of this prairie for many years to come.

In 1897 it was found necessary to deepen the outlet of the Brown Ditch at southern end of prairie. In order

to secure sufficient fall for further proper drainage, it was necessary to blast out a couple of feet of solid rock for the greater portion of the distance from the bridge just north of the Northern Ohio depot to the point where it empties into Spring Run. A portion of the southern arm of prairie just south of the Carey-Findlay road has been rendered fit for cultivation by means of a very extensive system of underground drainage. A walled catch-basin, receiving the water from several side arms, occurs just south of this road. A large tile drain carries this water to the southwestward.



FIGURE 9. BOWER DITCH JUST BEYOND LIMIT OF PRAIRIE, DEEPENED IN 1891.

4. LAGGING BEHIND OF EFFECTS.

On area D of Map II, although there are ditches on three sides of it producing excellent drainage, yet *Phragmites phragmites* (Reed) still flourishes fairly well. It is not as dense or rank as formerly, but it is yielding very gradually to the changed conditions, and

promises to hold out for some years to come. It is also holding its own in a few other well drained areas.

In the depressions of area F of Map II, *Typha latifolia* (Cattail) was very abundant before the last deepening of ditch, after which a gradual decrease in abundance occurred. Yet it was fairly common even in 1900, the year before the greater portion of this area was brought under cultivation.

Isuardia palustris (Mud Purslane) and *Proserpinaca palustris* (Mermaid Weed) are other striking examples of plants yielding slowly to the changed condition. A specimen of *Proserpinaca* was found late in the Autumn on a piece of ground which had been planted to potatoes. It survived in spite of cultivation, but it had changed its general habit. Instead of growing long and slender, it formed a dense mat about eight inches in diameter, which closely hugged the ground.

Salix myrtilloides and *Betula pumila* are frequently found growing along the well drained banks of ditches three to five feet deep, although they are characteristic swamp plants. The evident explanation of this lagging of effects is found in the facts of well developed root system of most of the plants cited in connection with the great water content of the muck of this prairie.

5. PLANT SOCIETIES OF THE PRAIRIE.

Although there is only a moderate difference in the surface level of the prairie, yet there are quite distinct plant societies flourishing in close proximity to each other. Some times the difference in surface level is not more than one or two feet yet on the slightly higher portion, a mesophytic forest formation may have been developed, while a hydro-mesophytic prairie society may be firmly established on the slightly lower level. Again on another part of prairie considerably higher than the wooded portion, a prairie society may be holding sway. Mere elevation can not reconcile these

seemingly contradictory plant societies. Upon closer examination, it was ascertained that, although the surface level of the muck differed but moderately, the drift clay beneath is not nearly so uniform in level. Consequently, while at some places the clay bed lies one or two feet beneath the surface, at others it lies at a depth unknown at present. On account of the dip of the rock strata of the ridges adjacent to the prairie, the lower strata of muck are surcharged with water, which prevents excavating a hole deep enough to determine depth of muck. A long iron pipe or wooden pole might be driven into the muck, but it would be impossible to determine, whether the entire distance of easy penetration were muck, quick sand, or a plastic mixture of sand and clay. For a conservative estimate we may state that the muck in some portions is at least eight or ten feet deep. As there is this difference in the nature and depth of the soil and sub-soil, and as in the neighborhood of the old lake remnant the soil is more sandy than elsewhere, and as the plant societies vary according to these factors, we shall deal jointly of the nature of the soil in the various portions and the characteristic plant societies thereon.

The first division of plant societies on Big Spring Prairie would be the wooded portions, and the Prairie proper. The wooded portions may be classified under the following divisions:

- 1 The Sand Dune Forest.
- 2 The Outcrop Forest.
- 3 The Clay Island Forest.
- 4 The Clay Bank Forest.
- 5 The Burned Area Thicket.

These divisions will be more fully treated of in the division of Forest Encroachment or Introduction upon Prairie, the Order and Cause.

The prairie proper supports various plant societies according to its elevation, proximity to ditches, and ef-

fects of prairie fires in the past. Furthermore, portions of prairie are still natural meadows; others are under a high degree of cultivation; still others were at one time cultivated, but, for a number of years past, have been used for pasturage again. Thus there is presented a varied array of plant societies according to the foregoing conditions and the problem of their ecology becomes quite a complex one.

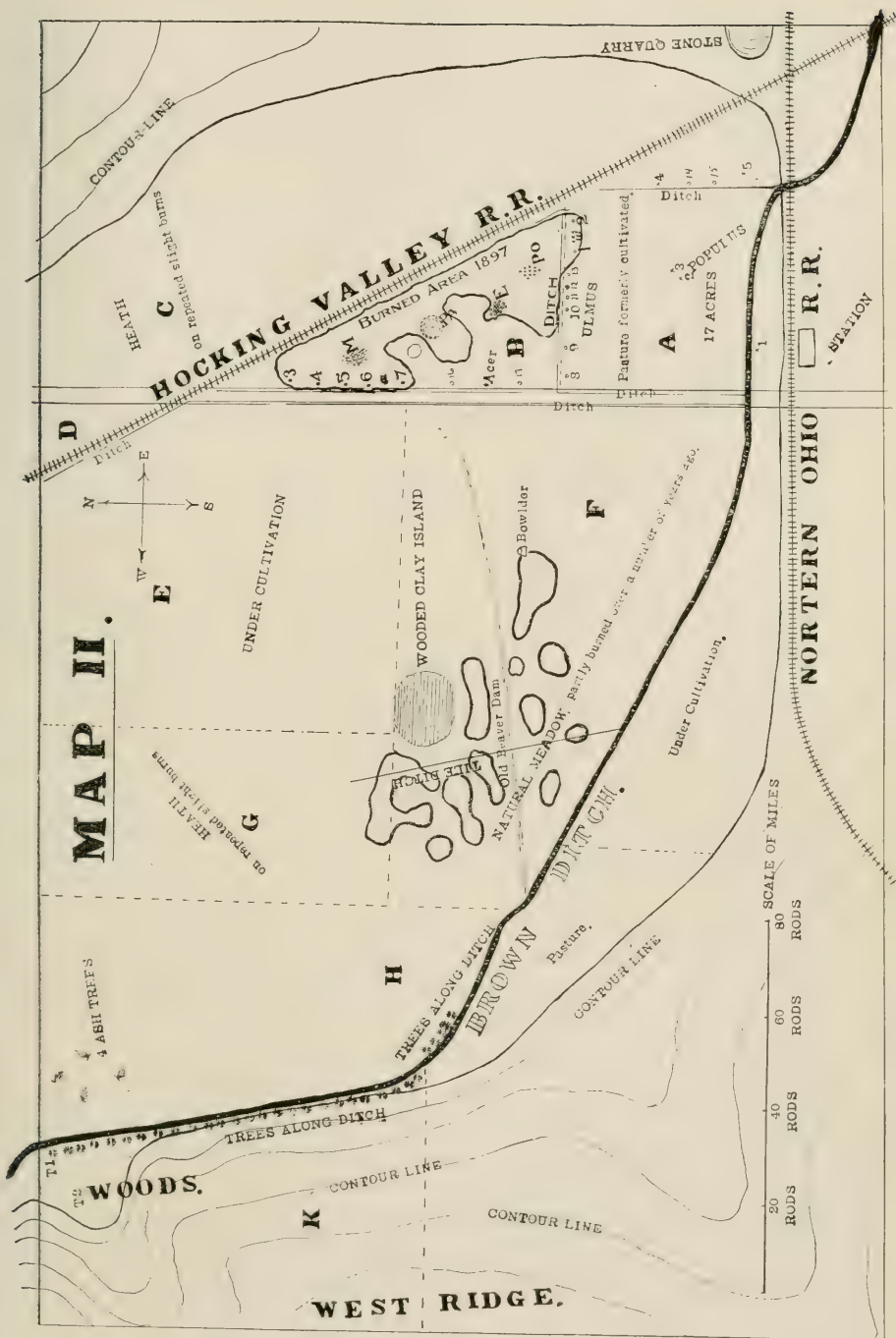
The prairie societies can be considered under the following divisions:

- 1 The Natural Meadow Societies.
- 2 The Heath Societies.
- 3 The Burned Area Societies.
 - a* On severe burns.
 - b* On repeated slight burns.
- 4 Meadow Societies on areas, formerly cultivated.
- 5 The Ditch Societies.

We shall first treat of the contiguous plant societies of the southern portion of the east arm of prairie, as, on the portion represented on Map II, all of the above prairie societies occur, and also some of the woodland societies.

The eastern portion of field "A" is slightly higher than the western, but not more than a foot and a half. Boulders of various sizes are quite numerous in eastern portion, only a few occurring in western portion. The soil in the eastern portion, as seen along ditches is from one and a half to two feet deep, consisting of three layers, a comparatively thick layer of muck, a medium layer of blue clay, and a thin layer of sand resting upon partially disintegrated native Niagara Limestone. The sand was most likely deposited along the shore of the old lake. About two blocks south of this field, the sand layer is considerably deeper as was observed in water-works trenches, which were in line of the original natural drainage course. How the blue clay came to overlie the sand layer is an unsolved problem, unless Les-

M A P I I



quereux's suggestion that the clay in ponds may be formed by remains of convervoideae and characeae is true.

The soil in the western part of field is from two to five feet deep with a similar arrangement of materials, but the muck and clay are relatively much thicker.

In fields B, F, and C the muck is deeper than in A, with the exception of the wooded clay island and its immediate vicinity. In H, G, E, and D the muck is of still greater depth.

Along the Brown Ditch in eastern portion of field F, the layers of muck and sandy clay are quite prominent, while along the ditch in western portion of field the muck only, is visible.

The surface of this field is quite irregular, especially the western portion, on account of the ravages of one or more severe prairie fires, which left a number of depressions of irregular outline and of varying extent. In 1896, these were from one to three feet lower than the surrounding portions.

Before the last deepening of the outlet of the Brown Ditch in 1897, these depressions contained more or less water throughout the entire year. Although the Brown Ditch was deepened only to the western extremity of field A, the remainder of ditch has become deeper by natural erosion. In 1899, a tile ditch was constructed as indicated on Map II. As a result, the depressions indicated by the banded areas, contained water only during quite wet weather.

In 1896, *Typha latifolia* L. (Cattail); *Isnardia palustris* L. (Marsh Purslane); *Proserpinaca palustris* L. (Mermaid-weed); *Scirpus lacustris* L. (Great Rush); *Ranunculus delphinifolius* Torr. (Yellow Crow-foot); and *Carex* (various species) were the characteristic plants, thus indicating the true hydrophytic conditions. In 1900, the *Typha latifolia* was becoming quite scarce, while the *Ranunculus delphinifolius* had entire-

materially decreased. The *Proserpinaca*, which still maintained its foothold in the lowest depressions, exhibited its characteristic tendency of producing simply toothed leaves instead of the dissected ones which the plant produces, when submerged. As the above species decreased in number, various species of *Carex*, *Scirpus*, and *Agrimonia parviflora* supplanted them.

The characteristic grasses, sedges and rushes of this natural meadow were *Poa pratensis* L. (Kentucky Blue-grass); *Agrostis alba* L. (Red top, Herd's-grass); chiefly in the southern and southeastern portion of field near the ditch; *Muhlenbergia racemosa* (Mx) B. S. P. (Marsh Muhlenbergia); *Scirpus atrovirens* Muhl. (Dark green Bulrush); *Scirpus cyperinus* (L.) Kunth. (Wool-grass); and *Juncus effusus* L. (Bog-rush).

The following were also common: *Spartina cynosuroides* (L.) Willd. (Tall Marsh-grass); *Carex lupulina* Muhl. (Hop Sedge); *Carex Frankii* Kunth. (Franks Sedge); *Carex comosa* Boot. (Bristly Sedge); *Carex vulpinoidea* Mx. (Fox Sedge); *Eleocharis* (species?) *Cyperus flavescens* L. (Yellow Cyperus); *Cyperus erythrorhizos* Muhl. (Red-root Cyperus); *Panicum crus-galli* L. (Witch-grass); *Homalocenchrus oryzoides* (L.) Pool. (Rice Cut-grass); and *Ixophorus glaucus* (L.) Nash. (Yellow Foxtail). The *Poa* and *Agrostis* occur in the best drained portions, while the marsh species flourish in the minor depressions.

The most characteristic herbaceous plants were *Eupatorium perfoliatum* L. (Boneset); *Solidago canadensis* L. (Canada Golden-rod); *Lycopus americanus* Muhl. (Cut-leaf Water Hoar-hound); *Verbena hastata* L. (Blue Vervain); *Asclepias incarnata* L. (Swamp Milk-weed); and *Agrimonia parviflora* Soland. (Small-flowered Agrimony).

Other quite common plants were *Potentilla monspeliensis* L. (Bushy Cinquefoil); *Mimulus ringens* L. (Sessile-leaf Monkey-flower); *Penthorum sedoides* L.

(Ditch Stone-crop); *Cardamine pennsylvanica* Muhl. (Pennsylvanica Bitter-Cress); *Epilobium lineare* Muhl. (Linear-leaf Willow-herb); *Polygonum* (4 species); *Coreopsis tinctoria* Nutt. (Garden Tickseed); *Iris versicolor* L. (Large Blue-flag); *Geum virginianum* L. (Rough Avens); *Urtica gracilis* L. (Slender Nettle); *Scrophularia marylandica* L. (Maryland Figwort); *Angelica purpurea* L. (Purple-stem Angelica); *Mentha piperita* L. (Peppermint); *Scutellaria galericulata* L. (Marsh Skullcap); *Phytolacca decandra* L. (Pokeweed); *Carduus muticus* (Michx) Pers. (Swamp Thistle); *Carduus lanceolatus* L. (Common Spear Thistle); *Erechtites hieracifolia* (L.) Raf. (Fire-weed); *Xanthium canadense* Mill. (American Cocklebur and *Ambrosia artemisiaefolia* L. (Ragweed). The *Mimulus*, *Penthorum*, *Cardamine* and *Iris* testify to the former marshy condition; the *Epilobium* and *Erechtites*, to the presence of fire.

The *Xanthium* owes its presence most likely to animals, as this field has been used extensively for pasturage. Species formerly fairly abundant in this meadow, but now rare are the following: *Lobelia cardinalis* (Cardinal Flower); *Lobelia syphilitica* (Blue Lobelia); *Lobelia Kalmii* (Kalm's Lobelia. Brook Lobelia) *Naumburgia thyrsiflora* (Tufted Loose-strife); all witnesses of the former marsh condition. Along the margins of the depressions the following shrubs occur:

Rosa carolina L. (Swamp Rose); *Ribes floridum* L. Her. (Wild Black Currant) and *Salix* (several species) (Willows). *Potentilla fruticosa* so common on other portions of prairie is not found in this meadow.

The wooded clay island will be taken up under the subject of Tree encroachment upon prairie.

FIELDS G. AND C.

These were heath-like areas covered chiefly with the following shrubs: *Potentilla fruticosa* (Shrubby Cinquefoil); *Sambucus canadensis* (Elderberry); *Salix* (several species, Willows) *Populus deltoides* and tremu-

loides, with *Urtica gracilis* as the most abundant herbaceous plant; and the following quite common: *Koeleria virginiana* (L.) MacM. (Virginia Mountain Mint); *Helianthus giganteus* (Tall Sunflower); *Thalictrum polygamum* (Tall Meadow-rue); and *Carduus nuticus* (Michx.) Pers. (Swamp Thistle).

FIELD B.

The unburned portion was still a natural meadow in 1899, and resembled field F. In addition to most of plants found in field F, the following were quite common: *Aster Novae-Angliae* L. (New England Aster); *Aster puniceus* L. (Red-stalk Aster); *Euthamia graminifolia* (L.) Nutt. (Bushy Fragrant Goldenrod); *Lactuca Scariola* L. (Prickly Lettuce); *Asclepias syriaca* L. (Common Milkweed); *Helianthus giganteus* L. (Tall Sunflower); *Onagra biennis* (L.) Scop. (Common Evening Primrose); *Roripa armoratia* (L.) Hitch. (Horse-radish); *Lactuca spicata* (Lam.) Hitchc. (Tall Blue Lettuce); *Potentilla fruticosa* L. (Shrubby Cinquefoil); and *Rubus occidentalis* (Black Raspberry).

In the Autumn of 1897, the shaded portion was severely burned. As a result the elms numbered from 1 to 7 were destroyed. The fire, burning the soil and roots from under the trees, caused them to fall, but yet did not consume them.

In 1898, the severely-burned spaces were covered with mosses (chiefly *Funaria hygrometrica*) and a few annual herbs. In 1899, some of these spaces contained hundreds of seedling elms and poplars; others were covered with rosettes of *Onagra biennis* and *Epilobum coloratum*; others, with *Muhlenbergia racemosa*; still others with *Panicum capillare*. Each of the foregoing have seeds that are readily disseminated and the ash of the muck does not seem to be detrimental to their germination. The south portion of the burned area contains more of the seedling elms and poplars than the re-

maining portion on account of its proximity to the seed bearing trees to the south and west of it.

FIELD A.

We treated first of the area surrounding this field so that we might note what plants from natural meadow were able to regain a foot-hold on this area; and what new species were competing with them.

This field has not been cultivated since 1886, and was sown to the following grass seeds: *Poa pratensis*, *Agrostis alba*, and *Phleum pratense*.

The trees occurring in this field are *Populus monilifera* indicated by x1, etc., and *Ulmus Americana* indicated by small circles. The diameters of the *Populus monilifera* were as follows: x1, two feet; x2, three feet; x3, one and one-fourth feet; x4, two and one-half feet; x5, one and one-half feet. The diameters of *Ulmus Americana* were 8, ten inches; 9, two and one-half feet; 10, one and one-fourth feet; 11, one and one-fourth feet; 12, one and one-half feet; 13, one one-fourth feet.

The trees are in a very flourishing condition, but the roots of those in the middle and eastern portion of field are very shallow, some radiating above the ground, partly on account of the settling of soil, partly on account of the shallow soil over the native rock. Dr. Asa Brayton, who owns the field states that the trees are voluntary, and that only a few of the largest were present before the ditches were dug.

The principal plants of the natural meadows to the West and North which have gained a foot-hold, are: *Koellia Virginiana* (L.) MacM. (Virginia Mountain Mint); *Vernonia fasciculata* Michx. (Western Ironweed); *Agrimonia parviflora* (Small-flowered Agrimony); *Euthamia graminifolia* (Bushy Fragrant Goldenrod); and *Solidago canadensis* (Canada Goldenrod). The following plants occur less abundantly than the above, but yet are quite common: *Aster Novae-Anglie* (New England Aster); *Lycopus Americanus* (Cut-leaf Water

Hoar-hound); *Eupatorium perfoliatum* (Boneset); *Potentilla monspeliensis* (Bushy Cinquefoil); *Aster vimineus* (Small white Aster).

The following occur still less frequently: *Rosa carolina*, *Asclepias tuberosa*, *Onagra biennis*, *Carduus marianus*, *Iris versicolor*, *Sambucus canadensis*, *Urtica gracilis*. From the cultivated ground the following are the most plentiful: *Achillea millefolium* (Millfoil or Yarrow); *Dipsacus silvestris* Mill. (Wild Teasel); *Oxalis*, (two species) *Ambrosia artemisiaefolia* (Bitterweed, Ragweed); *Chenopodium album* L. (Lambs-quarters); *Amaranthus retroflexus* L. (Rough Pigweed); *Nepeta cataria* L. (Catnip); *Rumex crispus* L. (Curled Dock); *Polygonum hydropiper* L. (Water-pepper); *Polygonum persicaria* L. (Lady's thumb); *Leptilon canadense* (L.) Britt. (Horse-weed) and *Convolvulus sepium* L. (Hedge Bind-weed). In the eastern portion of field, there are a few *Crataegus* and one specimen of *Gleditsia triacanthus*.

The introduced species in this field occur most commonly where there are breaks in the sod or upon the soil thrown from the ditches. A dense sod seems to be an effectual preventative against the encroachment of most species of plants. The plants which will gain a foot-hold upon the suitable places are chiefly those which occur on the areas around it to the windward, and under similar ecological conditions of soil, moisture, etc. This fact is strikingly illustrated in comparing field H, a natural grassy meadow along the western border of prairie, with artificial meadow A in the eastern portion. Fields F and B are closely allied in physical and chemical characteristics of soil to field A, and the wind is suitable for seed dissemination, in consequence, we find many species in common.

FIELD H.

This is a natural meadow. It is strikingly different in physical and chemical characteristics of soil from

the adjoining ridge, but very similar to that of F and G to the east of it. Although the prevailing winds are favorable, few if any ridge plants have become established upon it. Again as the prevailing winds are westerly, few of the species occurring on F and G are found upon H, although the ecological factors of nature of soil and water content are similar. The surface is well sodded with grasses and sedges, but very hummocky as shown in figure 10.

The next most characteristic plant is *Iris versicolor* (Iris or Blue Flag). Two species of *Polygonum* occur in moderate quantities. Few other plants are common. The *Iris* occurs also in the northeast corner of woods K.

In the northwestern corner of field there were four Ash trees, having the lower portion of trunk considerably enlarged and the roots prominent.

FIELD D.

Before the deepening ditches in 1897, the most characteristic plant of this small area was *Phragmites phragmites* (L.) Karst. (Reed). It is still quite common. Other fairly common plants *Salix* (several species), *Aster novae-angliae*, *Aster puniceus*, *Solidago Riddellii*, *Solidago Ohioensis*, *Verbena hastata*, and *Urtica gracilis*. One clump of *Chelone glabra* occurred also. The *Phragmites* are witnesses of the low marsh condition, and the *Solidago Ohioensis* and *Riddellii* of the wet prairie. The *Urtica gracilis* gives evidence of the occurrence of prairie fires. That there were no severe burns is evidenced by the fact that marsh and wet prairie species are still the dominant plants.

As the two divisions of Natural Meadows and Heath Societies gradually shade into each other, and as they possess many species in common, we shall treat of them jointly, beginning with the large area, occupying the greater portion of the territory between the two new roads indicated on map I.

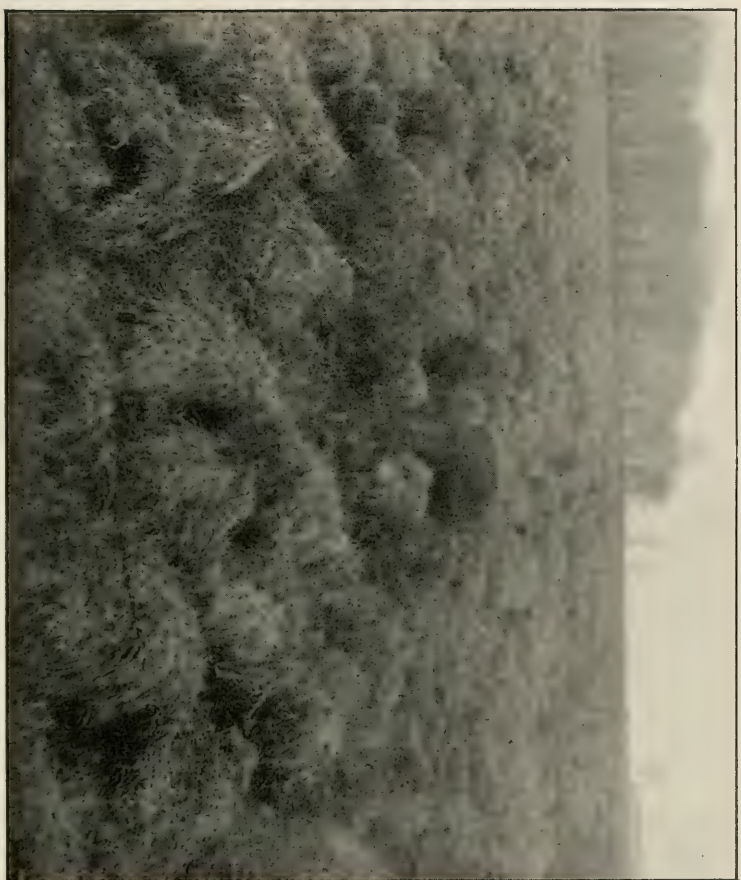


FIGURE 10. NATURAL MEADOW, FIELD H OF MAP II. GRASSES, SEDGES AND POLYGONUMS.

In the vicinity of new road No. 1, ditches were dug years ago along the eastern and western margins. As a result of this, the level of the soil along the margins was lowered, while accumulation still continued in the middle; accordingly at the time of the digging of the ditches along the middle of prairie, this portion was higher than that along the edges, presenting the phenomena frequently observed in undrained *Sphagnum* swamps. At present, there are two higher portions between the middle ditch and either margin of prairie. Although this portion was the highest part of this section, it possessed distinct and characteristic bog features. A short distance south of the divide there were two springs, and north of it three or more springs, of which Ox Spring was the most important. Some of these prairie springs are at present simply large depressions, filled with water during wet seasons, and in dry seasons, barely moist. The abundance of springs in this locality and their former importance, in connection with its position between the two ridges, accounts fully for its being the most elevated portion of prairie. The abundance of water, discharged by these springs, before the ridges were so extensively deforested, was especially conducive to the rapid accumulation of plant remains, as it prevented much loss from oxidation. This area seems to have possessed the necessary conditions for a *Sphagnum* swamp, but careful microscopic examination of the soil from this vicinity failed to reveal any traces of *Sphagnum*. Other mosses chiefly *Hypnum* species are quite abundant in the spring of the year. Since beginning the study of this section, this portion in immediate vicinity of Ox Spring has been brought under cultivation, and displayed a divergence from the general character of the surface soil of the prairie. Irregular patches and streaks of marly deposits occurred here and there. The origin of these deposits is due in great part to the lime deposited

from the evaporation of the water, which overflowed the surface of soil in vicinity of Ox Spring, and in part to the shells of fresh water mollusks inhabiting same.

The water from this spring, and in fact from all wells in vicinity of ridges is heavily charged with lime. This marly soil effervesces briskly when treated with hydrochloric acid. The surface muck to the east of this section is of a deep black color, but at the depth of 3 or 4 feet it is of a brown color, resembling in this respect peat from a Sphagnum swamp. A microscopic examination of this brown soil reveals the fact that over nineteen-twentieths of it is composed of purely vegetable matter, the cellular structure being well preserved. This lower stratum has the appearance, and slightly also the odor of well-rotted cow-manure. This brown muck when first exposed possesses a slight ammonia odor, which it soon loses. One form of plant remains consists of a wavy stem with $\frac{3}{4}$ inch internodes. The interior is well-rotted; the bark forms a brownish layer, which, after drying, crumbles under the least touch. It is this brown water-charged muck which gives that extreme spongy character to the soil. It would be interesting, if it were possible to determine whether this brown muck were due to the remains of *Philotria*, *Ceratophyllum*, *Utricularia*, *Myriophyllum*, etc., or to *Typha*, *Juncus*, *Phragmites*, *Carex*, etc.

As before mentioned this vicinity possesses the deepest muck. Fig. 11 represents this natural meadow as viewed northward from the divide. The ditch represented is about 5 feet deep, and flows northward. By a close inspection of the illustration, the surface along each side of the ditch is seen to slope toward it; this slope is due to the settling of soil incident to drainage and aeration. Between this ditch and the western margin of prairie, especially in the vicinity of the springs there occurs a plant society of the Heath type, three of whose species are quite characteristic of peat

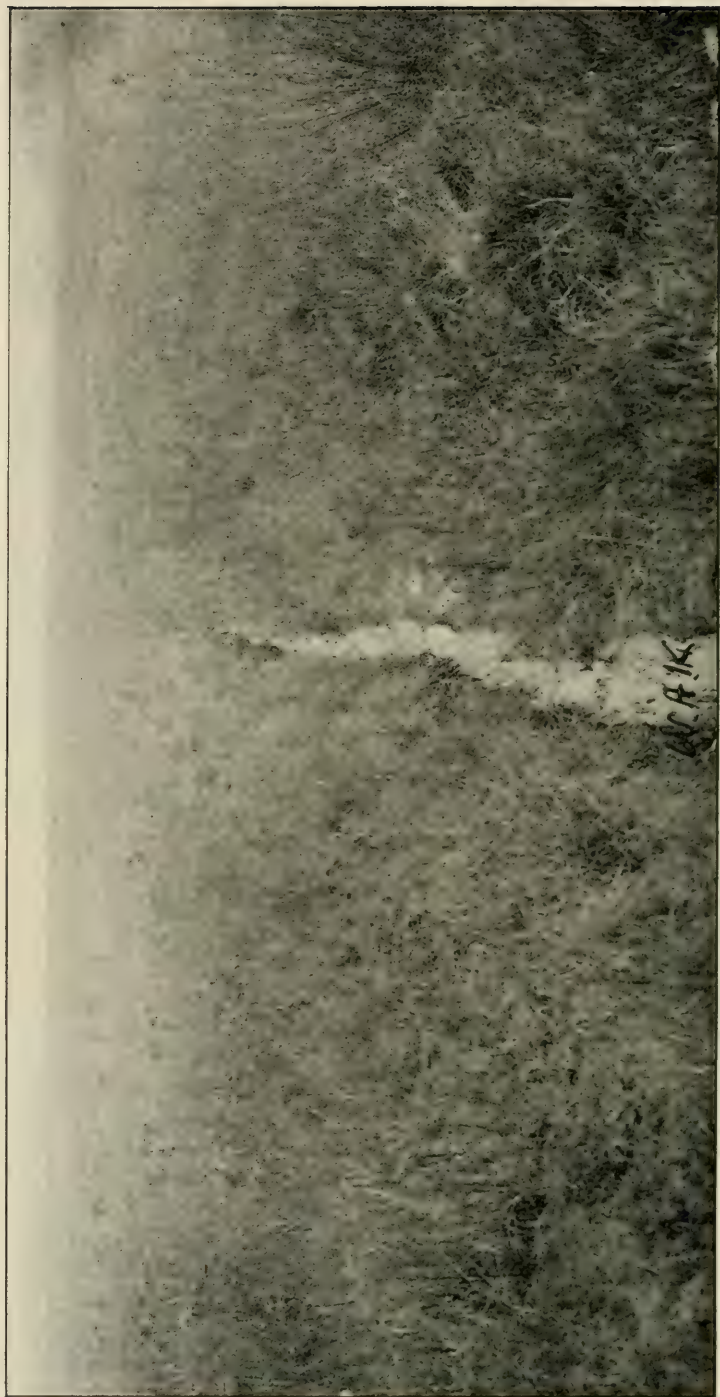


FIG. 11.—NATURAL MEADOW LOOKING NORTH FROM THE DIVIDE ALONG NEW ROAD NO. 1, AS SHOWN ON MAP I.

bog formations. It is a Hydro-mesophytic Society, and can best be designated as a *Potentilla fruticosa*, *Betula pumila*, *Salix myrtilloides*, *Rhus vernix* heath. The last three species are the characteristic and common plants of Sphagnum swamps, either the simple Sphagnum swamp such as occurs at Fox Lake, Wayne Co., Ohio, or the Tamarack Bog as the one on the Calumet flood plain at Millers, Ind.

It is still an unsolved problem whether these species are remnants of a former Sphagnum swamp, or whether they are ever associated together on areas where Sphagnum moss has never occurred.

Big Spring Prairie marks the southern limit for the range of *Betula pumila* in Ohio. Besides the *Salix myrtilloides*, there also occurs *Salix candida*, *Salix bebbiana*, and *Salix lucida*. The *Salix candida* is the next most common species to *Salix myrtilloides*. Close to the shallow old ditch along the western margin there occur occasional large willows and poplars. In some portions the *Potentilla fruticosa* predominates as in field just south of the divide, while at others there are various combinations of the remaining characteristic species. The remaining shrubby plants are *Rosa carolina*, *Cornus stolonifera*, and *Ribes floridus*, the last the least abundant.

The principle grasses and sedges are *Chrysopogon avenaceus* (Michx.) Benth. (Indian Grass); *Phragmites*, (Reed); and *Carex* (various species).

The principle herbaceous plants are *Solidago riddellii* (Riddells Goldenrod); *Solidago ohioensis* (Ohio goldenrod); *Allium cernuum* (Nodding Onion); *Lacinaria spicata* (Gay feather Devils-bit) and *Dryopteris thelypteris* (Marsh Shield Fern.) In fig. 11, the *Solidagos* are shown to the left of the ditch chiefly.

The *Allium* and *Lacinaria* in field in vicinity of Ox Spring were found to be by far the most abundant on the marly streaks and areas; they occur much less

frequently on the other portions of prairie. This may be a natural hint to the onion growers of this section.

Other species occurring less frequently are *Verbena hastata*. (Blue Vervain); *Euthamia grammifolia* (Bushy-fragrant Goldenrod); *Solidago canadensis* (Canada Golden-rod); *Aster novae-angliae* (New England Aster); *Aster puniceus* (Purple-stem Aster); *Aster paniculatus* (Tall White Aster); *Mimulus ringens* (Sessile Leaf Monkey Flower); *Penthorum sedoides* (Ditch Stonecrop); *Asclepias incarnata* (Swamp Milkweed); *Lobelia kalmii* (Brook Lobelia Kalm's Lobella); *Lythrum elatum* (Wing Angled Loosestrife); *Eupatorium perfoliatum* (Boneset); *Eupatorium maculatum* (Spotted Joe Pie Weed); *Parnassia caroliniana* (Grass of Parnassus); *Coreopsis tinctoria* (Garden Tickseed); *Helenium autumnale* (Sneezewort); and *Isnardia palustris* in the lower places. Along over-arching south-bank of a ditch flowing east, about $\frac{1}{4}$ mile south of the divide, there occurred patches of *Marchantia*, *Conocephalus*, and along the north bank, amid some shrubby cinquefoil *Geaster minima* was very common. Various other species of *Geaster* also occur on the prairie.

As we advance northward and eastward from the Ox Spring, the shrubs become less abundant and are also less rank. As the shrubs are low, and the grasses and sedges tall, this field looks like a grassy plain, similar to that shown in fig. 12, which represents breaking of virgin prairie for Celery farm. The taller grasses are *Chrysopogon*, the lower shrubs chiefly *Potentilla fruticosa*. Around immediate vicinity of some of the prairie springs *Cephalanthus occidentalis* (Button Bush) commonly occurs.

Near the Mound Springs occurs the most extensive natural meadow still extant and here also the portion near the series of springs is several feet higher than the prairie west and north of it. On this higher portion, near the margin of prairie the bog conditions are

FIG. 12.—BREAKING OF VIRGIN SOIL ON CELERY FARM. NATURAL MEADOW TO THE LEFT.



more prominent than in the lower area to the west and north, on account of the abundance of water discharged formerly by these springs, which preserved the accumulation of plant remains, as in the neighborhood of Ox Spring. This more elevated portion is characterized by its rather dense sod of grasses and sedges with its occasional *Solidago*, *Eupatorium*, *Dryopteris thelypteris*, etc.

To the west of this area there is another typical *Potentilla fruticosa*, *Betula pumila*, *Salix myrtilloides*, *Rhus vernix* heath, but the *Lacinaria spicata* and *Allium cernuum* are lacking, the soil here being a pure black muck of great depth.

The following are as common here as at Ox Spring: *Solidago riddellii*, *Solidago ohioensis*, *Solidago canadensis*, *Dryopteris thelypteris*, *Aster novae-angliae*, *Helenium autumnal*, *Agrimonia parviflora*, *Coreopsis tinctoria*, *Spathema foetida* is more common.

Ordinary weeds from cultivated ground seldom occur here as few slight, and no severe prairie fires have devastated this portion. The absence of severe prairie fires is chiefly accounted for by its distance from railroad. The sod is broken in such few places that seedling poplars and willows are not common. Still further to the west and north there occurs an extensive heath of the *Rosa carolina*, *Potentilla fruticosa* variety represented in fig. 13.

South of new road No. 2 there is an extensive *Rosa carolina*, *Sambucus canadensis*, *Potentilla fruticosa* heath. No willows or poplars of any consequence occur here now, although numerous young trees were quite abundant eight to ten years ago, as the remains were still strewn about upon the ground, or were still standing as dead trunks. Most probably they were destroyed by a prairie fire, severe enough to kill the trees, not severe enough to burn the soil.

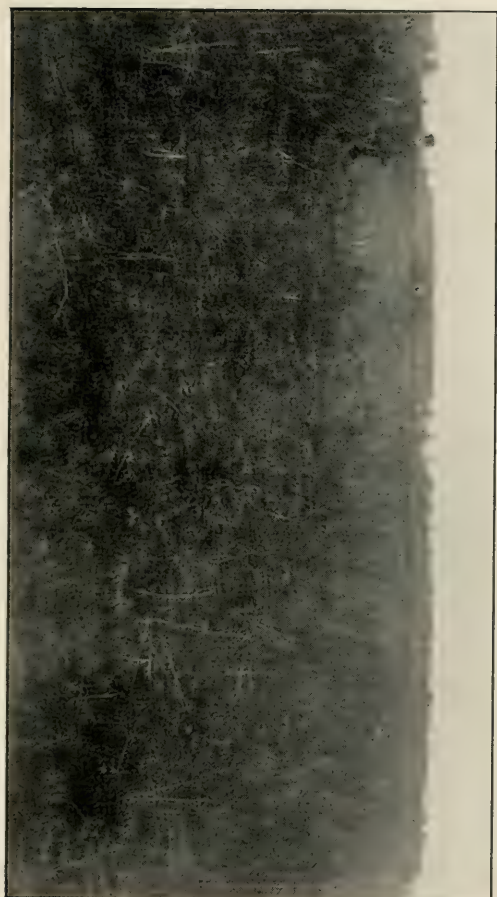


FIG. 13.—ROSA CAROLINA, BETULA PUMILA, POTENTILLA FRUTICOSA HEATH,
NORTH OF CAREY & FINDLAY PIKE.

Just north of the area represented by map II, there occurs a large area which has been repeatedly, but most of it not severely burned. The shrubs on this area are: *Salix fluviatilis* (Sand-bar Willow); *Salix bebbiana* (Bebb's Willow); *Lambucus canadensis* (Elderberry); *Rosa carolina* (Swamp Rose); *Potentilla fruticosa* (Shrubby Cinquefoil); but the *Rosa* and *Potentilla* are not as frequent as on those areas not visited by prairie fires. Occasionally *Populus monilifera*, *Populus tremuloides*, *Rubus villosus*, and *Rubus occidentalis* also occur. Where the sod is most completely destroyed *Urtica gracilis* is by far the most abundant plant, while *Thalictrum polygonum*, *Solidago canadensis*, *Koellia virginiana*, *Epilobium lineare*, and *Eupatorium perfoliatum* are next most abundant, as are also various species of *Bidens*, *Ambrosia*, and *Dipsacus sylvestris*. Where the sod is completely destroyed the *Urtica* and the weeds from cultivated ground predominate; on the other portions the original plants maintain their foothold. Those species with deepseated and extensive underground rootstocks are the most successful ones in holding their own. The general type of plant society of this prairie area would be designated as *Hydromesophytic*.

MEADOW SOCIETIES ON AREAS FORMERLY CULTIVATED.

At western extremity of prairie, and some distance south of the Bower Ditch there occurs a meadow of this type which contains 60 acres. It is extremely well sodded, but has been so closely pastured, that it was impossible to determine the species of grasses, but, most likely, the same combination of grass seeds were sown here as in the meadow just north of Carey. A woods occurred just west of the pasture field. This area differs from the two pasture fields discussed under map II, as there are so few species of plants to be found upon it.

No one species can be considered characteristic or even common. Here and there a stray *Erigeron*, *Potentilla*, *Aster*, *Ambrosia*, *Capsella*, *Ranunculus*, etc. may occur. This is another striking illustration of the results of location, environment, and direction of the prevailing winds; and also of the fact that most seeds require a bare soil for germination. A few smaller isolated areas of this class occur with characters intermediate between the above form and the area just north of Carey as figured on map II.

THE DITCH SOCIETIES

These would be divided into those plants growing directly in the ditches, and those flourishing on the banks. The principal plants growing directly in the ditches of this prairie are: *Lemna minor* (Lesser Duckweed); *Bidens laevis* (Smooth Bur-Marigold); *Coreopsis tinctoria* (Garden Tickseed); *Alisma plantago-aquatica* (Water Plantain); *Bidens frondosa* (Beggar-ticks); *Isnardia palustris* (Marsh Purslane); *Ludwigia polycarpa* (Many-fruited Ludwigia); *Eupatorium perfoliatum* (Bone-set); *Eupatorium maculatum* (Spotted Joe Pie Weed); *Verbena hastata* (Blue Vervain); *Xanthium strumarium* (Cockle-bur); *Homalocenchrus oryzoides* (Rice Cut-grass); *Typha latifolia* (Cat-tail); *Carex* (numerous species) (Sedges); *Bidens connata* (Swamp Beggar-ticks); *Helenium autumnale* (Sneeze-weed) and *Ambrosia trifida* (Horse-weed). Along the banks there flourish chiefly grasses, willows, young elms, young cottonwoods, and a variable number of other species depending upon the nature of the plant societies in the immediate vicinity.

6. TREE INTRODUCTION UPON PRAIRIE, THE ORDER AND CAUSE.

A number of theories have been advanced to account for the absence of trees upon prairies, but few to account for tree encroachment upon same. Most

theories which have been proposed in regard to either are made so general that there are nearly or fully as many exceptions to the rule as there are conformities to it. In the course of time, the forest formation is certain to encroach upon the eastern type of prairie or natural meadow, which, in general, can be more correctly designated as a semi-marsh. The problem before us is to determine the order, cause, and rate of encroachment.

The factors which determine order of tree encroachment upon natural meadow are relative elevation of the various portions, drainage, nature of the soil and the occurrence of suitable bare spots for germination of the seeds.

Drainage may be either natural or artificial. The natural drainage of wet meadows is secured either by the gradual elevation of one portion above another by the more rapid accumulations of plant remains on the former than on the latter, or by the erosion of some adjacent portion. The proper drainage of a portion of prairie remote from an artificial ditch may be secured indirectly by the settling of the soil in the space intervening between the ditch and the remote area. The suitable places for germination and growth of tree seedlings are furnished by sandy beaches, established sand dunes, or exposures of bare soil, caused by either prairie fires or artificial drainage.

On Big Spring Prairie the following order of encroachment has been observed:

- 1st. On the limestone or outcrop island indicated on map I.

- 2nd. On the sand beaches and sand dunes of the old lake.

- 3rd. On the clay banks along margins and on the clay islands of the old lake.

- 4th. On the bare soil thrown out of drainage ditches, or on the exposed slopes.

FIGURE 14. A NARROW SAND DUNE IN BIG SPRING TOWNSHIP, DESIGNATED IN TEXT AS WEST DUNE.



5th. On areas where sod and surface soil have been burned by prairie fires.

LIMESTONE OR OUTCROP ISLAND.

The highest portion of this area is about four or five feet higher than the surrounding prairie. There is no actual outcrop of Niagara limestone, but it is covered with a rocky clay soil, similar to that of the ridges. When this region came under the writer's observation, it was under cultivation, but some of the original trees were still standing. There were nine oaks in a flourishing condition, and three dead ones still standing. The oaks were chiefly *Quercus alba* (white oaks) There is no doubt but that this was the first wooded area of this prairie, the forest appearing but little later than that on the neighboring ridges, as the island was formerly much higher without doubt, and has been considerably worn down by erosion.

SAND DUNES AND BEACHES.

In Big Lick Township, Hancock county, there occurs an old sand beach or low dune along the slope of ridge as indicated on map I. This beach or dune was blown up by the north and northwest winds while the prairie site was still a lake. First, a sandy beach was formed, with its three zones of lower, middle and upper beaches as discussed by Dr. H. C. Cowles of the University of Chicago in his treatise "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan." Only here the zones would be narrower, and different species would occupy the upper and middle beaches of this area, from those found on the corresponding zones along Lake Michigan. It would be interesting to know what these first species were, but there is now no means of determining this, and it would be useless to speculate. On account of the slope of the ridge, the sand was blown up the slope

without forming a distinct or characteristic sand dune as commonly understood. It may have been more distinct in the past than at present. Now it may more properly be termed a sand slope.

The characteristic vegetation is quite similar to that found on the north slopes of the ridges, the oaks and hickories predominating. The grass is chiefly *Poa compressa*. A portion of this sandy slope is under cultivation.

In Big Spring Township, Seneca county, there occur three distinct dunes, two of them marked *S. D.* on map I, meaning simple dunes. The one to the southwest, illustrated by fig. 14, will be referred to as West Dune, the other as North Dune. M. D. C. indicates a Miniture Dune Complex.

By inspection of map I, it will be noted that these dunes are located between the Bower Ditch on the north and the outlet of the Big Spring on the south. As a natural stream, the Bower Ditch had eroded a perceptible valley on the ridge to the northeast, and had doubtless carried a considerable amount of silt into the old lake. The natural currents from the Big Spring and those from the south also carry some silt along. As these two silt laden currents encountered the sweep of the prevailing westerly winds, much of this silt was deposited, and in time, formed a sand bar or bank. After portions of this sand bar became sufficiently elevated to remain above the water throughout the year, low dunes would be formed by the action of the winds. Seeds would soon find lodgment, and plant life appear. The same currents which transported the silt, would also transport many seeds. The general order of the advance of plant life on these dunes would resemble that of the sand dunes along Lake Michigan. First, there would appear annuals, then grasses and sedges, which would act as binders of sand and in consequence low dunes would form; after this, shrubs and tree

seedlings would appear. A diversified flora would gradually develop from the natural introduction of various seeds, until we should find just such a flora as is found on the Minature Dune Complex, which is the oldest of these dunes. It was formed by the southwest, west, and northwest winds. The south winds chiefly heaping up the sand carried down from the Big Spring, which at present feeds the artificial lake represented in fig. 15. The surface is quite undulating from the irregular arrangement of the separate dunes formed by the alternate shifting of the winds. The highest portion of this dune complex is about seven or eight feet above the surrounding level. The humus overlying the dune sand is from eight to twelve inches deep. The underlying sand is very fine and a typical dune sand of unknown depth. The depth of humus would indicate that this dune complex is quite old, as would also the fact that this area was densely wooded in 1832, when the Indian Reservation was thrown open to settlement. Its age would also be indicated by its diversified flora.

The wooded area can be divided into the dune complex proper, and a lower portion to the north and northeast of it.

On the dune complex proper, the most abundant trees are:

Ulmus Americana (American Elm); *Quercus alba* (White Oak); and *Acer saccharinum* or *rubrum* (Silver Maple or Red Maple.)

Besides the above the following occur:

Populus deltoides (Cottonwood); *Prunus serotina* (Wild Black Cherry); *Quercus imbricaria* (Shingle Oak); *Fraxinus Americana* (White Ash.)

On the low ground adjoining the following species occur:

Ulmus Americana (American Elm); *Quercus palustris* (Pin Oak or Swamp Oak); *Quercus platanoideis*

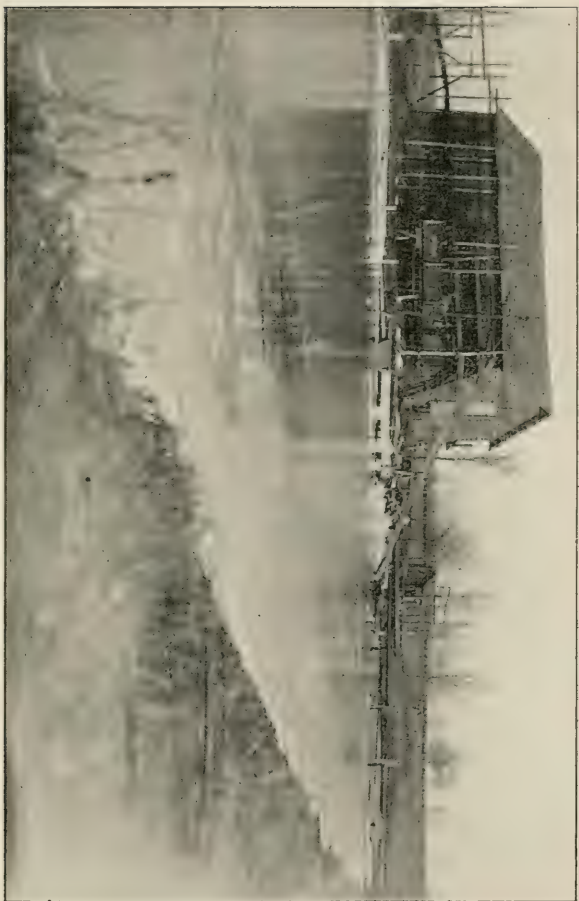


FIGURE 15. ARTIFICIAL LAKE FED BY BIG SPRING.

(Swamp White Oak); *Acer rubrum* (Red Maple); and *Fraxinus* sp? (Ash.)

The diameters of some of the larger trees were as follows:

White Oak, 32 inches; White Oak, 42 inches; Cottonwood, 38 inches; American Elm, 41 inches, and American Elm, 55 inches.

Thus, the size of the trees corroborate the testimony of the pioneers in regard to the wooded condition of this area in 1832.

On the simple dunes, about the same species occur that are found on the dune complex, but the *Populus deltoides* (Cottonwood) is more abundant as is evident from an inspection of fig. 15, which represents a portion of West Dune, the white-barked trees from the middle to the left of picture being cottonwoods.

As proof of the more recent formation of West Dune, we submit the following diameters of trees:

Populus deltoides (Cottonwood) 24 inches; *Quercus alba* (White Oak) 18 inches; *Prunus serotina* (Wild Red Cherry) 15 inches; and *Ulmus americana* (American Elm) 32 inches. The trees of North Dune are as a rule larger than those on West Dune and not as large as those on the dune complex. Between the two single trees there occurs a solitary *Quercus rubra* (Red Oak) 56 inches in diameter. All of these dunes are characterized by a regular jungle of shrubby plants. On the Miniature Dune Complex the principal shrubs are *Crataegus* (several species) (Hawthorns); *Cornus stolonifera* (Red Osier); *Rhus glabra* (Smooth Sumac); *Rubus villosus* (Common Blackberry); *Rubus occidentalis* (Black Raspberry); *Corylus americanus* (Hazelnut); *Euonymus atropurpureus* (Wahoo, Burning Bush); *Euonymus obovatus* (Running Strawberry Bush); *Vitis* (sp?) (Wild Grape); *Smilax herbacea* (Carrion flower); *Smilax hispida* (Hispid Greenbrier); *Celastrus scandens* (Climbing Bittersweet); *Parthenocissus quin-*

quefolia (Virginia Creeper); *Rhus radicans* (Poison Ivy); *Staphylea trifolia* (Bladdernut); *Sambucus canadensis* (Elderberry); *Lonicera* (sp?) (Honeysuckle); *Spiraea* (sp?); *Viburnum* (two species) (Arrow wood); *Malus coronaria* (American Crab-apple); *Salix* (several species) (Willows); *Populus deltoides* (Cotton wood); *Populus tremuloides* (Trembling Aspen); and *Cornus florida* (Flowering Dogwood). In all there are twenty-five or more species, some forming a sort of zone along the edge of forest.

On West Dune only the following eight shrubs and young trees were observed:

Euonymus atropurpureus (Wahoo); *Euonymus obovatus* (Running Strawberry); *Viburnum prunifolium* (Black Haw); *Rubus villosus* (Common Blackberry); *Cornus stolonifera* (Osier); *Parthenocissus quinquefolia* (Virginia Creeper); *Vitis* sp? (Wild Grape); *Populus tremuloides* (Trembling Aspen.)

The Dune Complex, being richer in genera and species, indicates conclusively its priority in formation. Perhaps the West Dune was formed when there was only a lake remnant, and there was not the same opportunity for the transportation of suitable seeds by water currents, as there was in the case of the Dune Complex. It would also indicate that the seeds were introduced upon the Dune Complex by water currents rather than by wind dispersal, or else the disparity in number of genera and species upon these two dune areas would not be so great, as they are only a short distance apart.

If the prevailing westerly winds were the chief factor in the introduction of new species in this region, the West Dune ought to be much richer in species than it is, as for many years past, it must have intercepted the seeds from this source. Perhaps this accounts for the greater abundance of Cottonwoods on the West Dune.

The density of shrubby growth is fully as great on the West Dune as on the Dune Complex, but there is no sod upon the former, while portions of the latter are densely sodded.

The difference in herbaceous vegetation is still more striking than in the case of the shrubby plants.

On West Dune the following were the principal herbaceous plants:

Galium (two species) (Cleavers or Bedstraw); *Circaea lutetiana* (Enchanter's night shade); *Viola pubescens* (Downy Yellow Violet); *Viola canadensis* (Canada Violet); *Geranium maculatum* (Wild Cranesbill); *Podophyllum peltatum* (May Apple); *Polygonatum biflorum* (Hairy Solomon's Seal); *Scrophularia marylandica* (Maryland Figwood); *Arctium lappa* (Burdock); *Urtica gracilis* (Slender Nettle); *Botrychium virginianum* (Virginia Grape-Fern); *Onoclea sensibilis* (Sensitive Fern.)

On the Dune Complex the following were the most common and characteristic herbaceous plants:

Bicuculla cucullaria (Dutchman's Breeches); *Vagnera racemosa* (False Solomon Seal); *Vagnera stellata* (Stellate Solomon's Seal); *Erythronium americanum* (Yellow Adder's Tongue); *Trillium grandiflorum* (Large Flowered Wake-Robin); *Polygonatum biflorum* (Hairy Solomon's Seal); *Podophyllum peltatum* (May Apple); *Hydrastis canadensis* (Golden Seal); *Ranunculus* (several species) (Buttercups); *Washingtonia longistylis* (Sweet Cicely); *Dentaria laciniata* (Cut-Leaf Pepper Root); *Anemone quinquefolia* (Wood anemone); *Caulophyllum thalictroides* (Blue Cohosh); and *Cardamine purpurea* (Purple Bitter-Cress)

Other common plants are:

Geranium maculatum (Wild Crane's Bill); *Viola* (several species) (Violets); *Scrophularia marylandica* (Maryland Figwort); *Circaea lutetiana* (Enchanter's Nightshade); *Heuchera americana* (Alum Root); *Trios-*

teum perfoliatum (Horse Gentian); *Arisaema triphyllum* (Indian Turnip); *Hydrophyllum virginicum* (Virginia Waterleaf); *Thalictrum dioicum* (Early Meadow Rue); *Urtica* (two species) (Nettles); *Polygonum virginianum* (Virginia Knotweed); *Apocynum androsaemifolium* (Spreading Dogbane); *Zizia aurea* (Early Meadow Parsnip); *Aquilegia canadensis* (Columbine); *Onoclea sensibilis* (Sensitive Fern, *Botrychium virginianum* (Virginia Grape Fern); *Dryopteris* sp? (Shield Fern); *Adiantum pedatum* (Maiden-hair Fern); *Solidago* (several species) (Goldenrods); *Heliopsis helianthoides* (Smooth Oxeye); *Hystrix hystrix* (Bottle-brush Grass); and *Aster* (various species) (Asters.)

In the low portion of the woods were *Eupatorium ageratoides* (White Snake Root.)

The following were rare plants not only for this dune complex, but even for this entire vicinity:

Cypripedium parviflorum (Smaller Yellow Lady's Slipper); *Viola pedata* (Birds-foot Violet); *Unifolium canadense* (False Lilly-of-the-Valley); and *Panax quinquefolium* (Ginseng).

The writer has failed to find the last two specimens anywhere else in this neighborhood during twelve years of botanizing. The first two are rarely found in this vicinity. These are strong witnesses for the comparatively greater age of the Dune Complex over the others, and also of the varied conditions prevailing upon this area in former times.

By an inspection of the above lists it will be seen that herbaceous plants are fully four times as numerous on the Miniature Dune Complex as on the West Dune.

The North Dune contains a few more specimens than the West Dune, but not nearly as many as the Dune Complex. One plant common to the North Dune has not been observed on either of the others, namely: *Spathyema foetida* (Skunk Cabbage), although it is quite abundant on various portions of the prairie.

WOODS ON CLAY BANKS AND CLAY ISLANDS.

These two divisions may be considered together, as the same factors of shallow muck and a clay subsoil are common to both. By even a slight drainage the water will move down the clay incline, giving the proper condition for the development of thickets followed by forests upon it. Mr. Peter Brayton stated that a thicket originated in the vicinity of new road No. 2 after the first ditch was dug. The clay subsoil continues the slope of the adjoining ridge. In consequence, there was developed a thicket extending from a point southwest of the Big Spring in a westerly and southwesterly direction. In 1895 it was far more extensive than is figured on Map I, for by 1899, many acres had been cleared and brought under cultivation.

One of the first trees to make its appearance upon these areas is *Populus deltoides* (Cottonwood), succeeded by *Ulmus* (Elm), *Acer* (Maple), and *Fraxinus* (Ash). The trees in woods just south of new road No. 2 were from 10 to 15 inches in diameter.

Fig. 16 represents Clay Island of Map II. This area in 1899 contained four elms over 3 feet in diameter, and two over 2 feet in diameter, besides a few smaller ones. There were also about 50 small ash trees, some of which originated from the stumps of former larger trees, as sometimes from four to six of these trees are grown together at the base. All of these trees exhibited the characteristic prominent roots. Some of the clay islands were wooded before the first ditches were dug. The effect of ditching was to cause a more rapid encroachment of forest upon the surrounding portions which were underlain by a properly sloping clay-subsoil. By 1886, the forest had encroached considerably upon the prairie to the southwest, south and southeast of it where the proper natural slope of clay subsoil occurred. In this year a severe prairie fire destroyed



FIGURE 16. WOODS ON CLAY ISLAND REPRESENTED ON MAP II.

about all of the trees upon the newly occupied area. Upon most of this area between the depressions represented on Map II, numerous young trees of *Populus deltoides* (Cottonwood); *Populus tremuloides* (Trembling Aspen); and *Ulmus americana* (American Elm), were gaining a foothold.

One of the clay islands in the western part of the prairie contains only Elms. The other clay islands or clay banks represented exhibit slight variations in the relative number of the species enumerated above, but all of the species are characterized by the prominent or exposed roots.

Fig. 17 represents a peculiar formation of a Maple tree which occurs a short distance southwest of one of the clay islands in the western part of the prairie. The clay-bed gradually sloped from the island in either direction. After drainage a seedling maple sprang up and flourished for several years. As the muck is deeper here than on the island, the tips of the larger roots only were imbedded in the clay; as a result the tree could not successfully withstand the strong wind to which it was exposed. When it was blown down, the roots were not broken off as commonly happens, when they are imbedded in hard soil. The roots on the windward side were torn loose, and have decayed as can be noted by a careful inspection of cut.

Those on the side nearest the prostrate trunk were but little disturbed. Hence the tree continued its growth. The principal branches survived in their struggle for existence, the other branches being shaded gradually decayed, and the resulting formation ensued. This is an apt illustration of a successful struggle for existence under adverse conditions. The illustration shows in the back-ground another tree not so successful in its struggle. The mere looseness of soil on prairie where muck is quite deep may be sufficient reason to account in part for the absence of trees of any size on such areas.

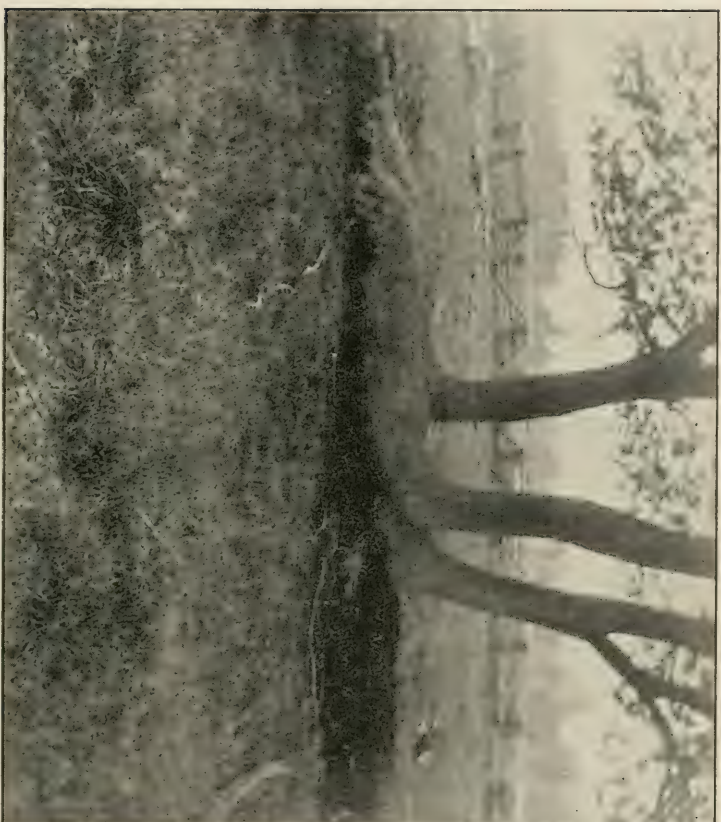


FIGURE 17. ALONG EDGE OF A CLAY ISLAND ON WESTERN PORTION OF PRAIRIE.

The area just south of the new road, No. 1, marked W. B. (*wooded bay*) was formerly a bay of the old lake. The silt carried down from one of the drainage valleys gradually helped to fill this up. In time, it passed through successive stages until it became eventually well wooded. The woods was cleared off, and the area was brought under cultivation. At a depth of 10 or 12 inches there is a flaky sort of soil, which burns with a bright blaze similar to cannel coal. The extent of this deposit was not ascertained, but most probably is quite limited in thickness and extent. The texture of this soil is much firmer than the muck on other portions of prairie, and loses less in weight and volume on drying than the muck from other portions of prairie. The loss in burning is considerable, but was not tested quantitatively.

The northeast corner of woods K of map II, was formerly a small bay into which one of the drainage valleys emptied. After it became filled up with silt and plant remains, a marsh condition arose; and such plants as Iris and Spathyema made their appearance. These plants still survive in the woods in spite of the rather thorough drainage. In this bay there was a gradual slope of the clay bank to the northeast; and after first ditch was dug, seedling elms and ash sprang up in the muck soil, as now there was moving water in the soil instead of stagnant water. The roots extended through the muck and into the clay sub-soil. As the soil settled after drainage, the roots became considerably exposed as represented in figure 2 and 3. After the settling of the soil, some of the trees were blown down as the roots did not furnish sufficient support to resist wind action. Many of the trees are leaning more or less and as some of the exposed roots are gradually decaying, many more will succumb in the near future, and a forest suited to the new conditions will gradually supplant it if left in a state of nature.

APPEARANCE OF TREES ALONG DITCHES.

It is a well known fact that trees and shrubs commonly occur along ditches or water courses even in the west. Whenever drainage ditches are dug upon the eastern type of prairie, a variable number of trees make their appearance along their banks; the number and kind of trees depending upon kind and quantity of seeds finding lodgment upon the bare soil. The amount of seeds received will depend upon proximity to source of supply, and the direction of the prevailing winds at the time of seed-dispersal.

On Big Spring Prairie, those ditches occurring near forests, (especially if the forests are so situated that the prevailing winds can be instrumental in wafting the seeds to the bare soil along them) are apt to exhibit a greater number of species, and also a greater number of individuals of each species, than those ditches not so favorably situated.

Fig. 18 represents a row of trees which sprang up after the digging of the Brown Ditch. This row of trees occurs partly on the western bank of ditch, and partly on the eastern bank as indicated on Map II.

This row of trees consists of

	DIAMETER
79 <i>Ulmus americana</i> (American Elm).....	6 to 30 in.
5 <i>Prunus serotina</i> (Wild Black Cherry)....	3 to 18 in.
3 <i>Platanus occidentalis</i> (Sycamore).....	12 to 24 in.
3 <i>Juglans nigra</i> (Black Walnut).....	6 to 18 in.
2 <i>Fraxinus</i> sp? (Ash).....	10 to 12 in.

The trees occur along the very margin of ditch. The roots on the ditch side are considerably exposed on account of erosion, occasioned by the deepening of the outlet of ditch. From the foregoing list, it is evident that the elms are by far the most abundant species. This is true of nearly all the other ditches. On the very slopes of the ditches along new road No. 1, numerous cottonwoods and willows are springing up, as the



FIGURE 18. TREES ALONG DITCH REPRESENTED ON MAP 11.

seeds find such ready lodgment upon this bare soil, and the conditions seem to be suitable for their germination, especially upon the banks sloping to the south. Here there is a proper amount of light and heat in connection with the ever-present moisture in this muck soil. Along some few of the ditches, willows are the predominant trees or shrubs. Maples occur only occasionally.

Most of the trees figured on Map II, originated along ditches, and an inspection will show that elms and poplars are the abundant species.

On the Peter Brayton farm in Big Spring Township, Seneca County, there occurs a peculiar group of trees along one of the ditches. This group comprises several maples ranging from 18 inches to 30 inches in diameter, a few elms, a couple of oaks, a black haw, an ash, a dogwood, and several willows of 14 to 15 inches in diameter.

TREES ON BURNED AREAS.

Prairie fires have been frequently assigned as the cause of prairies and the absence of trees upon them; but on Big Spring Prairie, fires are the direct cause of the encroachment of thickets and forests upon it. If a prairie fire burns simply the tops of the dead grasses, but does not destroy the sod and roots, ordinary weeds make but little headway in gaining foothold. Schimper gives, as the cause of the density of sod, the fact that grasses propagate abundantly by vegetative reproduction, and adds that this very density of grass rootstocks and roots with their great capacity for the absorption of soil moisture is one of the chief hindrances to the germination of the seeds of trees and to the flourishing of tree seedlings. Herbaceous plants, not including grasses, can not engage in contest against woody plants.

On an area on which sod and soil are burned, mosses and a few annual herbs make their appearance

the first year. The herbs become more abundant the second year and tree seedlings also make their appearance at this time.

On Map I, between the Seneca-Wyandot County line and new road No. 2, there is indicated the location of one of the most extensive thickets or embryo forests on this prairie. Figure 19 gives a view of this thicket from the southwest. The larger trees to the right are cottonwoods. In the Autumn of 1891 or 1892, a severe prairie fire originated from a spark from a Hocking Valley engine. As a result the sod and soil were burned away to a depth of one to two feet. The year after the fire, mosses and annual herbs appeared, succeeded the next year by seedling cottonwoods and willows.

In 1899, the circumferences of three willows at one foot above the ground were as follows: 11 in., 14 in. and 15 in.; of eight cottonwoods were 12 in., 13 in., 14 in., 16 in., 16 in., 17 in., 17 in. and 18 in. Those of less dimensions were very numerous, thus showing that all the seedlings did not make their appearance the same year. In the latter part of the eighties, a prairie fire burned quite a depression near the railroad, just across from the wooded bay (W. B). The trees sprang up only around the margin. In 1899, the trees, chiefly cottonwoods and willows, were from 7 to 14 in. in diameter.

A short distance northeast from the woods which presents such excellent examples of exposed roots from the settling of soil, as shown so strikingly in fig. 2 and 3, there stood in 1899, a thicket of cottonwoods, trembling aspen, and willows. This area had been burned over some years before, and the largest trees were from 15 to 20 feet high, while there were all gradations down to dense patches of seedlings of the season of 1899. In the autumn of this year, the writer had the opportunity of noting the effect of prairie fire on young trees. A prairie fire burning only the



FIGURE 19. THICKET ON SEVERE PRAIRIE BURN ON THE PETER BRAYTON FARM.

surface covering of weeds and sedges swept over the greater portion of this thicket. In 1900, it was noted that less than half of the seedlings had succumbed to the flames. The remainder were still in a fair growing condition, while on the bare spots many tree seedlings sprang up during this season. In 1901, this area was brought under cultivation, and thus ended any further observations. The herbaceous vegetation in this thicket consisted chiefly of *Urtica gracilis* (Slender Nettle); *Ambrosia trifida* (Horse weed); *Bidens* (various species) (Spanish needles); and *Polygonum* (various species) (Smartweeds); making a rank vegetation for the flames to act upon, and yet only a portion of the young trees were destroyed.

On area B, of Map II, several trees from 8 to 12 in. in diameter were burned down in 1897, but in 1899 tree seedlings were already taking possession of portions of this area. In 1900, it was brought under cultivation, and no further stages could be noted.

On Map I, other detached areas of varying extent are indicated. Each case, upon examination, reveals the fact that destruction of sod is the potent factor in the introduction of weeds and tree seedlings upon Big Spring Prairie, and probably upon any of the eastern type of prairies.

BURIED FORESTS.

While some workmen were digging ditches on the H. B. Phelps Celery and Onion Farm just north of the woods showing settling of soil by the prominent roots, indicated on Map I, numerous trunks of trees were encountered. The diameters of these trees vary from 6 inches to about 3 feet. Near the Brown Ditch the tree remains occur near the surface, while further away the tree trunks were found at a depth of 2 to 4 feet. When this find occurred, the writer surmised that it might be a buried tamarack forest, but a microscopic

examination of numerous specimens proved that none of them were conifers. The species could not be definitely determined, but there is no doubt that several species occurred. The species most probably were cottonwoods, elms, ash, and willows. Even if the exact species can not be definitely determined, the fact remains that a forest formerly flourished on a rather large area, where within the memory of man, only a typical semi-marsh existed. It is also an indisputable fact that this forest was destroyed from some cause, and preserved in an accumulation of plant remains. Since the cause is practically unknown, it may be in order to offer a possible and probable theory in regard to the matter, especially as some further data concerning the depth and nature of the various soil strata have been secured since writing the portion relating to that subject. While drilling a well on the Phelps Celery Farm just south of the Brown Ditch, the following strata were encountered and depths of each were learned:

Muck	6 ft.
Clay shading into marl.....	3 ft,
Marl, quicksand and gravel	9 ft.
Total	18 ft.

The gravel rests directly upon the rock strata, which are here 18 feet below the surface. About 40 rods or so north of this well, the strata were found to be of the following depths:

Muck	8 ft.
Clay shading to marl	3 ft.
Marl, quicksand and gravel.....	9 ft.
Total	20 ft.

As the surface slopes from the latter well toward the former, the rock strata are nearly horizontal.

This arrangement and nature of strata proves con-

clusively that this area was a lake in past glacial times, and incidentally corroborates the conclusion that it was a preglacial drainage valley, as the rock strata near the western end of prairie are 30 feet beneath the surface. As the surface level is lower here than at the points before mentioned, it is evident that the stream flowed northward and westward. The gravel, sand and marl were deposited when the lake was quite deep, and before the abundant aquatic plant life became established. The position of the clay bed seems to confirm Lesquereaux's explanation in regard to formation of such strata in ponds and sluggish streams from the remains of chara and allied plants. After bulrushes and cat-tails made their appearance the formation of the muck layer began. After a shallow layer of muck had accumulated over the clay bed, the area must have become sufficiently elevated to secure natural drainage enough to enable tree seedlings to make their appearance. The clay subsoil offered a sufficiently firm support for successful tree growth. After the forest became established, it is possible that the natural drainage outlet became obstructed, perhaps by the beaver dam before mentioned. In consequence the forest would be flooded and the trees destroyed.

Buried forests have also been reported as occurring on the Vanlue end of the prairie, and may in the future be found to have existed on other unexplored portions. It is indeed a peculiar area scientifically, as it is proving practically to the celery and onion growers.

THE PRAIRE UNDER CULTIVATION.

Before the first artificial drainage, the cultivation of any portion of the prairie was impossible. Even after the first artificial drainage, only isolated portions were cultivated. Drainage was resorted to chiefly to render the prairie safer for pasturage, as cattle and horses frequently mired in this marsh.

Corn was the crop most commonly grown, but it was found from experience that only three paying corn crops could be grown on any area consecutively. The first year's yield was excellent in quantity and quality; the second year's good; and the third year's fair. After the third year the yield was small, and of inferior quality. Wheat and oats were tried, but generally proved unsuccessful, as they would go down before they ripened on account of the lack of silicates and potash in the soil. On limited portions where the muck is not deep and, where, at the same time, there is a clay subsoil, wheat and oats can be successfully grown. These crops prove successful also in immediate vicinity of the sand dunes, as the soil here is quite sandy.

In a field just north of new road No. 2, clover was sown as an experiment, but it did not flourish very well, as too many weeds seemed to be able to gain a foothold and thus crowd out the clover. Several of the areas formerly cultivated have been sown to a mixture of grass-seeds, and furnish excellent pasturage. If not too closely pastured, these areas seem to possess the power of preventing other forms of vegetation from gaining much of a foothold. When too closely pastured, partially bare spots are produced, and here other forms of vegetation establish themselves and gradually encroach upon the pasture land. The large pasture field in the western part of prairie is a good example of the former, while the pasture indicated by *A* on Map II. is a good example of the latter.

In 1895 the Wild Rose Celery Farm was established by Mr. W. C. Johnson, now deceased. Being a practical gardener and celery grower, and being acquainted with the nature of various other drained marsh areas of the state, he recognized the value of this prairie land, which, before this time, was valued at about \$10.00 an acre. After Mr. Johnson demonstrated its fitness for celery and onion culture, the land rose

rapidly in value. Before the real value of the land was known, little effort was made to check the ravages of prairie fires, unless they threatened fences and other property; but now such means are employed as are illustrated by Fig. 5. Mr. Johnson was practically acquainted with the Creston Marsh, Scioto Marsh, Hog Creek Marsh and other similar areas. He knew what amount of ditching was required to render these marshes fit for successful culture of the various crops to be grown upon them. On the Creston Marsh, a five to ten acre field surrounded by ditches is well drained, while but little more ditching is required to drain the Scioto and Hog Creek Marshes. Mr. Johnson, not recognizing that Big Spring Prairie is a peculiar area on account of the great water content of the soil and its capacity for holding same, at first, constructed his lateral ditches 25 rods apart. He soon learned that this was not sufficient to drain this land properly, and, after experimenting, found it necessary to construct either tile or open ditches every 4 rods. On account of the origin of the soil water from the enclosing ridges, the temperature of this soil is lower than that of the other marsh areas mentioned; but this very factor renders this area most suitable for the successful culture of celery and onions. It also accounts for the presence of the *Betula pumila* and the *Salix myrtilloides* on the natural prairie areas. Fig. 20 gives a typical scene on Wild Rose Celery Farm.

In 1901, Mr. Edwin Brown caused the heath *C* of Map II. to be cleared off, and 20 acres of it were planted to onions. This crop netted him about \$1200. This gave an added impetus to the cultivation of the prairie. At present the principal crops are onions, celery, potatoes, and other garden truck. The various onion growers are learning from experience that the amount of drainage required on other marsh areas of Ohio with which they are acquainted, is not adequate for the successful cultivation of the Big Spring Prairie.

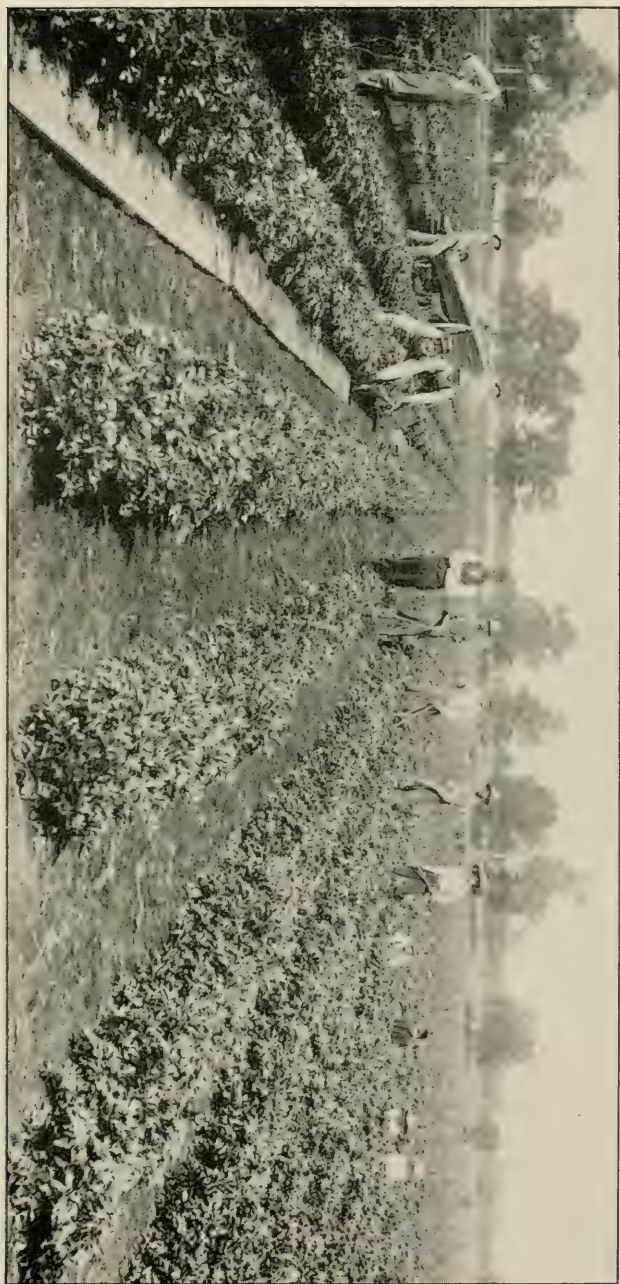


FIGURE 20. SCENE ON WILD ROSE CELERY FARM OF MR. W. C. JOHNSON.

For the successful culture of the above mentioned crops, the soil must be treated with fertilizers containing potash and phosphates. On account of the increased value of this land, there will be little of the natural prairie remaining in a few years.

A BRIEF COMPARISON OF BIG SPRING PRAIRIE WITH
OTHER DRAINED MARSHES IN OHIO.

The Scioto Marsh is drained by the Scioto River. There are no enclosing ridges of limestone with their practically impervious inclined strata. In consequence the water content of the soil of the Scioto Marsh is less than that of Big Spring Prairie, while at the same time the oxidation of the plant remains was more thorough. As a result of this the soil of the Scioto Marsh becomes finer under cultivation, and as the water content is less, the dry surface soil is more readily blown about by the winds. From this cause, the onion crop on the Scioto Marsh is frequently destroyed. The wind blows the soil away from the onions, and the roots become exposed, and the crop is thus ruined. This is not so likely to happen on Big Spring Prairie, as the water content of the soil is greater, especially on that portion northwest from Carey, hemmed in by the two adjacent ridges. In 1902, a considerable portion of the onion crop on Big Spring Prairie was injured partly by a late frost and partly by a peculiar sand-blast action of the fine particles of sand driven along the surface by strong winds. The onions were not blown out, as they frequently are on the Scioto Marsh, and the destruction was by no means total. Furthermore, since the above sand-blast action can occur only when the surface soil is dry, and while the onion tops are young and tender; and, as dry weather in the Spring is rather rare in this section, there is little likelihood of frequent repetitions of the above.

The following table gives a comparative view of the constituents of the soil from Hog Creek Marsh, Scioto Marsh, and Big Spring Prairie.

The analyses were made by Prof. Herbert M. Hill, Chemist, University of Buffalo.

Soil From	No.	Nitrogen as Ammonia	Phosphoric Acid P_2O_5	Potash K_2O	Moisture at 100° C.
Hog Creek Marsh...	1	1.26	.10	.10	59.22
" " " ...	2	1.49	.038	Trace	61.81
Scioto Marsh.....	3	1.099	.09	.10	67.38
" " "	4	.95	.13	Trace	66.02
" " "	5	.90	.09	.10	50.01
" " "	6	1.40	.07	Trace	66.36
" " "	7	1.44	.10	.15	53.36
Big Spring Prairie.	8	.99	Trace	Trace	78.01

Soil No. 8 was taken from the Wild Rose Celery Farm, at a depth of about 10 inches. Thus it is evident that the soil from Big Spring Prairie contains most moisture, and that it is not as rich in ammonia and phosphoric acid as the soils from the two preceding marshes. The Castalia Prairie differs radically from Big Spring Prairie, Scioto Marsh, and Hog Creek Marsh. The wonderful springs at Castalia with their immense volume of water, heavily charged with lime and other mineral ingredients, have occasioned extensive marl deposits, which are valuable for the manufacture of Portland Cement. The muck or humus over the greater part of this prairie is very shallow, accordingly, drainage will affect the general level but little. There are some moderately elevated hills to the south of this prairie, while the northern portion slopes gradually toward Sandusky Bay. According to the statements of Mr. W. H. Rowell of Castalia, and other pioneers of that section, the most common and characteristic plant formerly was *Phragmites phragmites* (reed.) At present it occurs only at a few isolated localities,

chiefly along the north and south road some distance west of the Cement Works. On a few limited areas, the muck is deeper than commonly occurs on this prairie. Some years ago, a prairie fire burned the soil on one of these areas, and gradually a forest developed upon it. Southwest of Castalia Station, there occurs a low woods, which about a century ago, was doubtless a portion of the prairie. This woods contained principally the following species:

Populus deltoides (Cottonwood); *Ulmus Americana* (American Elms); *Hicoria minima* (Swamp Hickory); *Quercus macrocarpa* (Mossy-cup Oak); *Celtis occidentalis* (Hackberry); *Tilia Americana* (Basswood, or Linden); *Acer (saccharinum or rubrum)* (White Maple, or Red Maple.) Thus showing a close approximation to the typical mesophytic forest.

Since the artificial drainage of the northwestern portion of prairie, thickets of cottonwoods and willows are springing up, as the humus is thin and extensive marl deposits underlie it. This marl deposit forms a firm support for the roots. Thickets of the same species are also developing upon those portions where the surface soil has been disturbed and then abandoned, but where dense sod occurs on areas formerly cultivated, tree seedlings seldom encroach. Certain portions are almost pure *Potentilla fruticosa* heaths with occasional *Crataegus* scattered about. The following plants occurring on Castalia Prairie do not occur on Big Spring Prairie: *Hypoxis hirsuta* (Star-grass); *Aquilegia canadensis* (Columbine); *Cypripedium candidum* (Small White Lady's Slipper); *Houstonia* (species) and *Gentiana crinita* (Fringed Gentian.) The following common plants of Big Spring Prairie were not found at Castalia: *Betula pumila* (Low Birch) and *Salix myrtilloides* (Bog Willow), thus it is evident that Big Spring Prairie more closely resembles a *Sphagnum* Swamp than does Castalia Prairie.

BRIEF SUMMARY OF FACTS IN REGARD TO BIG SPRING
PRAIRIE

1. Big Spring Prairie is a peculiar marsh area, when compared with other drained marshes of the state.

2. This prairie was most probably a portion of a preglacial drainage valley, and without doubt, a post glacial lake.

3. The water content and capacity of the soil of this prairie is above the average. This fact accounts for the striking lagging behind of effects in regard to plant life.

4. The low temperature of the soil water accounts for this prairie's marking the southern limit for the range of *Betula pumila* in Ohio.

5. Artificial drainage has considerably lowered the general level of the prairie. Occasional deepening of the ditches will be needed on this account.

In the drainage of other marsh areas, this lowering of the general level must be taken into account. There must be sufficient fall in the outlet ditches, not only for proper immediate drainage but for drainage in the future when the soil has settled.

6. Few ridge species of plants ever gain a foothold upon the prairie.

7. Direction of prevailing winds in connection with location of any given area, as along eastern or western borders of same; determines largely the number of species upon it.

8. A dense sod tends to prevent the encroachment of other forms of vegetation, especially tree seedlings. It is not so effective against shrubs as is evidenced by the heath formations.

9. Burning of soil causes reversions of plant societies in the depressions; on others it leads to establishment of forests, This is especially true if the

depth of muck is decreased to such an extent that roots of trees can penetrate to a firmer stratum.

10 Trees require a firm support for their roots. Consequently, successful tree growth can not occur where muck is deep and loose.

11. Order of tree encroachment upon prairie was as follows:

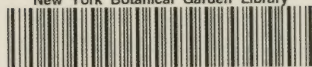
- (a) On limestone island.
- (b) On sand dunes or beaches.
- (c) On clay islands or clay banks.
- (d) Along drainage ditches.
- (e) On severely burned areas.

12. Portions of this prairie were formerly wooded, as is evident from the buried forests. Forests probably destroyed by flooding on account of construction of beaver-dams.

13. The highest portions of natural prairie possess the most distinctive marsh characters.

14. Parallel ditches at intervals of four rods needed to drain this area properly for the successful cultivation of the best paying crops.

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